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AN ARCHAEOLOGICAL RESEARCH DESIGN PROJECT FOR THE ABO OIL AND GAS FIELD, SOUTHEASTERN NEW MEXICO

by

Meade F. Kemrer
Timothy M. Kearns

submitted to

Bureau of Land Management
Roswell District
P.O. Box 1397
Roswell, New Mexico 82201

February 1984

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Chapter 1

INTRODUCTION

This report summarizes the data obtained, the resultant interpretations, and the predictive modeling scheme developed for the Abo Archaeological Project, a Bureau of Land Management sponsored Class II cultural resources survey.

The work was conducted under terms established by contract number YA-553-CT2-139, concluded between the Bureau of Land Management and Chambers Consultants and Planners of Albuquerque, New Mexico. The project was administered by Ann Ramage, District Archeologist, who was designated Contracting Officer's Authorized Representative on behalf of the Bureau of Land Management, Roswell District Office. Dr. Meade Kemrer, Principal Investigator, administered the project on behalf of Chambers Consultants and Planners (CCP), Albuquerque, New Mexico. Timothy Kearns served as Project Director for CCP.

The survey encompassed 12,000 acres represented by 150 eighty-acre sample units in Chaves County, southeastern New Mexico (Figures 1.1 and 1.2). The study area is within the Roswell Resource Area of the BLM Roswell District. It is located roughly between parallels 33°30' and 34° and meridians 104°49' and 109°9' and encompasses the area within Townships 4S to 9S and Ranges 21E to 26E. The community of Roswell is slightly south of the study area and the Chaves County and De Baca County line borders the study area on the north.

The Abo project area includes portions of the Sacramento Plain, the Diamond A Plain, the Pecos River terraces, floodplain and valley east to the edge of the Mescalero pediment. The Pecos River flows north to south through the eastern portion of the study area; the Capitan Mountains lie roughly 24 miles to the west, and the Llano Estacado lies roughly 20 miles to the east. Access to the project area is provided primarily by U.S. Highway 285 and secondarily by U.S. Highway 70 and New Mexico State Highway 20. A variety of county, ranch and well pad roads were utilized for access to specific sample units.

The project was sponsored by BLM in response to the increasing demand for fossil fuels to meet energy needs. The study area is within what is termed the Abo "tight" sand formation, a geological unit rich in oil and gas reserves. As exploration and development of these resources continues, BLM is under increasing pressure to provide adequate guidance and management decisions for the cultural resources potentially threatened by these activities. BLM is required to identify, evaluate and protect prehistoric and historic cultural resources on public lands under its jurisdiction and to insure that Bureau-initiated or Bureau-authorized actions do not inadvertently harm or destroy non-federal cultural resources. These requirements are mandated by the Antiquities Act of 1906; the Reservoir Salvage Act of 1960, as amended by P.L. 92-291; the National Historic Preservation Act of 1966, as amended; the National Environmental Policy Act of 1969; Executive Order 11593 of 1971; and the Federal Land Policy and Management Act of 1976.

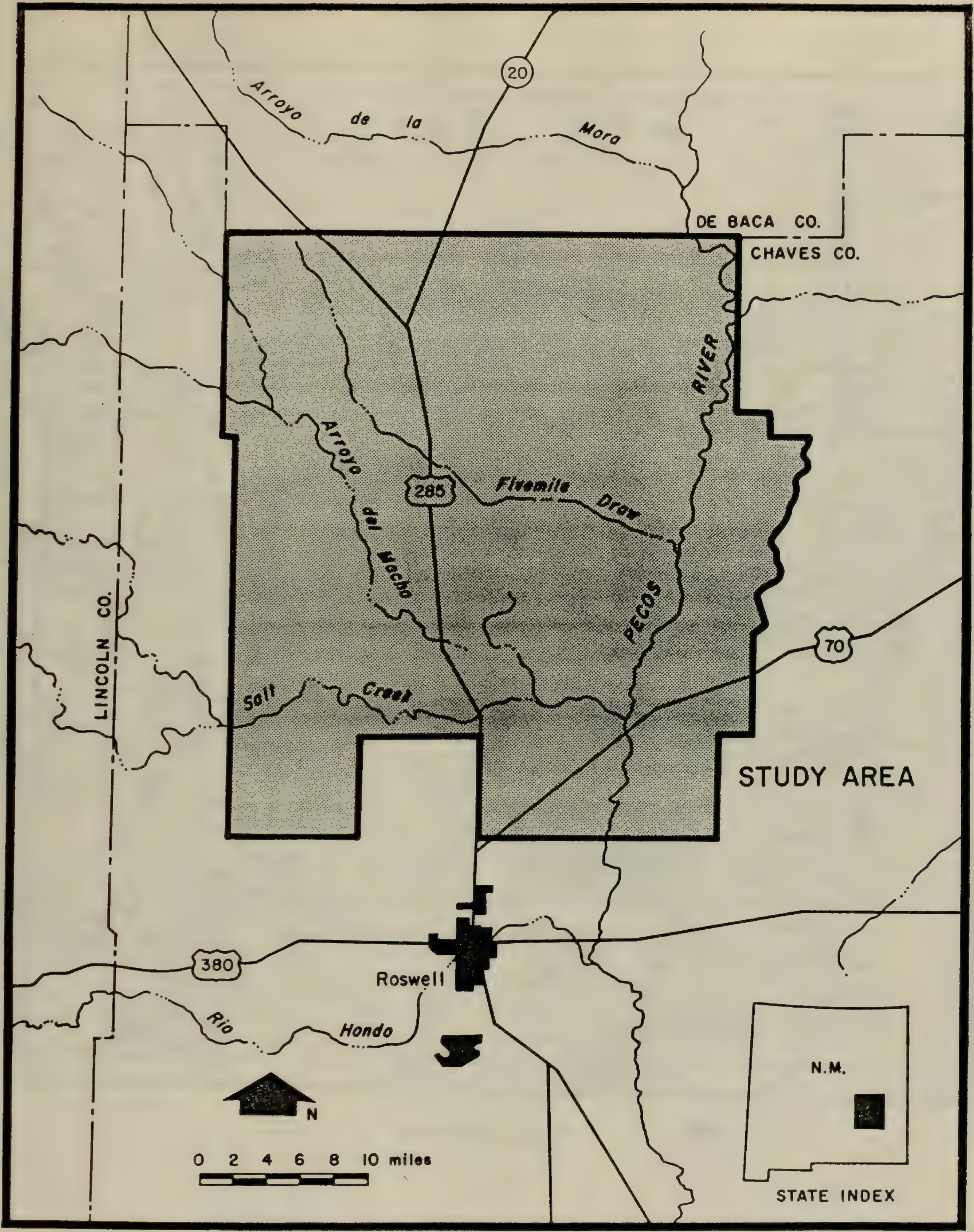


Figure 1.1
General Location of the Abo Study Area

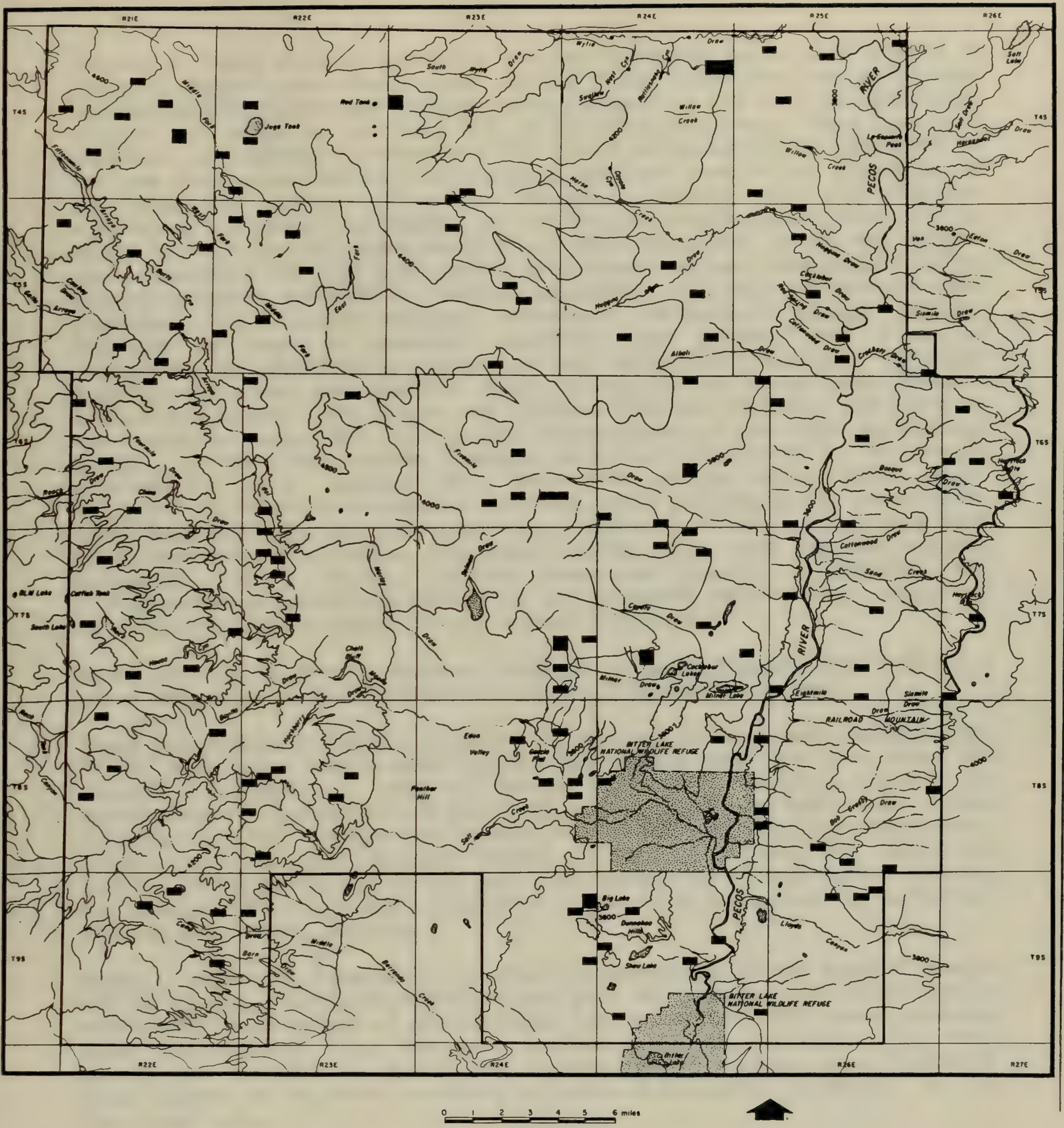


Figure 1.2
Abo Project Area Showing Distribution of Sample Units

Presently, when cultural resources are found during preliminary survey of proposed impact areas (well pads, access roads, pipelines, etc.) the BLM management evaluation and decision making regarding the need for avoidance, analysis and mitigation are dealt with on an individual basis. From a cultural resources management perspective, the actual consequences of increased oil and gas development for the archaeological resource base in the Abo field are not presently known. Therefore realistic, efficient and cost effective compliance management strategies are not in place for implementation. In an effort to expedite the management of cultural resources in the Abo "tight" sands formation the BLM first needed a synthesis of basic information on the cultural resource variability. Desired information included: estimates of site population by cultural-temporal affiliation, settlement pattern models, definition of areas of resource sensitivity and density, and a set of parameters for significance assessment and mitigative treatment. Although regional syntheses are available which encompass the study area (Camilli, Allen and Scurlock 1979; Stuart and Gauthier 1981:259-290) they are typically too broad in scope for the specific requirements of the Abo management needs. Several other survey projects have been conducted in the project area vicinity (e.g., Jelinek 1967; Bond 1979: Kelley 1966; Clifton 1973). However, the research orientation of these latter projects is too parochial to fulfill BLM needs for the Abo study area. Similarly, other surveys have been conducted to meet immediate management needs (e.g., well pad and pipeline surveys). As a result, cultural resources content, variability and spatial/locational patterning could not be estimated with a high degree of reliability without systematic sample survey information.

In an effort to obtain the necessary cultural resource data the BLM outlined a set of objectives to be completed in a series of sequential phases.

Phase I objectives included a synthesis of existing site data and archaeological survey data for a "model area" considerably larger than the area slated for sampling; developing a research design and survey sampling strategy to identify strong "predictors" of site location, and assessing differential spatial patterns vis-a-vis cultural and behavioral variability in the Abo study area. These objectives were directed toward developing a predictive model for cultural resources location in the Abo study area. An interim report (Kemrer and Kearns 1982) previously submitted to the BLM documents the activities, methods and results of Phase I.

Phase II objectives focused on the field implementation of the Class II sample survey design. Particular attention was paid to collecting and monitoring a statistically valid sample of archaeological and environmental/location variables which are deemed to be important predictors of site location. The field survey also provided an opportunity to identify and evaluate other variables which appear to regulate variability in cultural resources sensitivity in the Abo study area.

Phase III objectives emphasized the presentation of a formal probability-based model of cultural resource location in the Abo study area, and recommendations regarding the appropriate usage of the model for cultural resources compliance management for the Abo field. Other objectives of this final phase of the project include presenting survey results, assessing

cultural resource significance, and recommending guidelines for mitigation. These results, as well as the outcomes of the previous phases of the project, are described and documented in this report.

As noted, this report is designed to fulfill the Phase III requirements. Chapter 2 provides additional background information including a summary of the Phase I synthesis and results as well as a summary of the Phase II sampling and fieldwork methodology. Chapter 3 presents the Class II survey results including analyses of artifact variability and identification of the site typology. Chapter 4 addresses the analysis of site distribution particularly in reference to the predictive model developed for the study area. Chapter 5 discusses the evaluation and significance of the Abo study area cultural resources. Chapter 6 presents management recommendations including suggestions for inventory procedures, site recording strategies, and mitigation recommendations.

Chapter 2

PROJECT BACKGROUND

2.1 INTRODUCTION

This chapter provides a summary review of the development and progress of the Phase I data compilation and modeling effort for the Abo Archaeological Project. This is followed by an outline of the sampling strategy employed for the Phase II survey as well as a summary of the logistical aspects of the Phase II fieldwork. Included is a review of the selection strategy, the number, size and location of the sample units, followed by a summary of the project dates, personnel and field methodology.

2.2 IDENTIFICATION AND SUMMARY OF PHASE I

Phase I of the Abo Archaeological Project entailed the initial development of a cultural resources predictive model. This phase was performed by ESCA-Tech (Kemrer and Kearns 1982). A computerized cultural resources data base was created from existing data available at the State of New Mexico central repository, the Laboratory of Anthropology in Santa Fe, as well as the files of the BLM District Archaeologist at Roswell.

The archaeological data categories utilized by Kemrer and Kearns (1982:9-10) corresponded to those employed by the Laboratory of Anthropology in their computerized data management system, the Archaeological Resource Management (ARM) system. Data categories included the Laboratory of Anthropology Site Number (LA number), site type, and cultural/temporal affiliation.

The data file initially developed included sites located within and immediately adjacent to the Abo sample area shown in Figures 1.1 and 1.2. The sites used in modeling, however, were those within the sample area.

An environmental/site locational data base was also created. The variables used for modeling were those which could be quantified into ordinal values, a prerequisite for the kinds of analyses to be applied to model development. The quantity and quality of environmental data available for the Abo study was severely limited. A sufficiently refined soils classification and map was not available for the entire Abo sample area, although the Soil Conservation Service has recently completed the survey and mapping of northern Chavez County (Lenfesty 1982). Vegetation mapping data were developed by the Roswell BLM range managers, but were available in sufficient detail only for the BLM grazing leases. Other data which could be sufficiently fine grained for modeling purposes and which could have been extracted from aerial imagery were not available, since photo coverage on file with BLM did not include much of the sample area.

As a consequence of these problems, the data utilized for model development were those which could be taken directly form USGS topographic maps. The

variables and modes of analysis selected were similar to those used by previous investigators (cf. Larralde and Chandler 1981; Zier and Peebles 1982; Kvamme 1983) This approach involves the production of a site location model (or models) based upon those environmental characteristics which archaeologists have identified for many years as important factors which prehistoric subsistence based people often incorporated into their site locational strategies.

In all, seven location variables were monitored for each previously recorded site within the Abo sample area. The first of these, elevation advantage, quantifies the amount of advantage above the surrounding terrain that a site exhibits. This variable was measured by feet using the USGS topographic contour lines. The parameter for calculating this value was a 500 meter radius from the center of the site. This variable was designed to capture any site location patterning where elevation advantage might be important, such as game monitoring activities. Such patterning in site location has been documented in New Mexico (e.g. Irwin-Williams 1973; Judge 1973) and in the Llano Estacado region of southeastern New Mexico and the Texas Panhandle (Wendorf and Hester 1962).

The second location variable, local relief, refers to the total range of elevation measured in feet within a 500 meter radius from the site center. This provides a measure of terrain brokenness in the vicinity of the site. Again USGS topographic contour lines were used to measure this variable, and was calculated by summing the number of contour lines within the 500 meter circle and multiplying this sum by the contour interval. The amount of terrain brokenness has been found to contribute to site location in New Mexico (cf. Carroll et al. 1976).

The third location variable, distance to water was measured as the linear distance in meters from the site perimeter to the nearest potential water sources as indicated by blue lines on the USGS topographic maps. Playas and sinkholes were also included as potential water sources. Most water supplies in the Abo study area are ephemeral and dependent upon local seasonal precipitation. Water, of course, is a critical resource in the American Southwest and strong spatial associations between sites and water supplies have often been archaeologically documented (cf. Gumerman 1971).

Drainage rank is another water resource characteristic that was also monitored, since this variable has also proven to regulate site location (Gumerman 1971). To compute this variable, the highest order drainage in the study area, the Pecos River, was assigned a drainage rank value of one, and lesser tributaries were assigned successively higher rank values. The highest rank value in the Pecos system falling within the Abo study area is eight. However, there are relatively numerous "dead end" ephemeral drainages which flow into playas, sinks, basins or disappear into the ground. These were assigned a rank value of nine. Discrete but more reliable water sources such as playas, sinks and springs were assigned a drainage rank value of one.

Another variable which can potentially regulate site location is slope. This variable was measured as a grade percentage using a USGS Land Area and

Slope Indicator. When several slopes were exhibited within the perimeter of a site, they were averaged to obtain a single value.

Aspect or site exposure was measured on the USGS Topographic maps from the center of the site and is numerously measured by the compass bearing (expressed in degrees) for the direction that the site faces. Site locations are frequently patterned by aspect. In the American Southwest, prehistoric agriculturalists frequently located sites on southerly exposures for warmth in the winter and to maximize the length of the growing season (cf. Gumerman 1971). Aspect also reflects site placement vis-a-vis dominant windflow patterns, a significant factor for prehistoric hunters (cf. Wendorf and Hester 1962).

The last of the location variables, view angle, was monitored for each site. This variable is a quantitative estimate of the amount of surrounding terrain visible from a site. The view angle was measured from the highest elevation within a site and was formally defined as the number of degrees in the angle measured from the site's highest point that would encompass all elevations lower than that point (Brown 1979:197). Thus a site on the top of a hill would have a view angle of 360 degrees, while a site at the base of a linear cliff would have a value of approximately 180 degrees. Archaeologists have often noted that view angle was often highly patterned for prehistoric hunter-gatherer sites (cf. Judge 1973).

2.2.1 Phase I Model Development Analytic Methods

The option to develop site locational rather than a site frequency or density model was assessed to be the more appropriate approach to meet BLM's management needs regarding oil and gas development in the Abo field. Since oil and gas related impacts are not areally extensive, site density does not necessarily vary directly with the likelihood of adverse effect. Therefore it was more reasonable to discover where on the landscape sites are likely to be located and to quantify that likelihood. Management applications of a location model could include (1) individual probability assessments of proposed impact areas to determine the odds that a given location could impact a cultural resource; and (2) the spatial distribution of highest to least preferred site settings to gauge sensitivity within the Abo study area.

Another pragmatic reason for developing a site locational rather than a site density model in Phase I of this project was related to meeting data requirements. Density models require tract type survey data and thus only those sites which were identified in tract survey could be used. Very little tract type survey had been performed in the Abo area. Most sites had been discovered by reconnaissance surveys or extremely small oil and gas related surveys. In all fewer than 50 previously recorded sites had been located in surveys of land parcels equal to or greater than 40 acres within or adjacent to the Abo study area. Therefore insufficient data were available to initially develop a site density model. In contrast, site location models are developed from point rather than tract data, so virtually all previously recorded sites could be used for modeling. A site locational model was developed using a total of 279 previously recorded sites.

Each site was measured according to the seven locational variables, coded and compiled into a data base. Two major types of analysis were conducted with these data in order to assess site location patterning, the number of such patterns, and to monitor the relative strength or suitability of the location variables selected for this initial modeling effort. Programs available in the SAS (Statistical Analysis System) software package were selected for these analyses.

The first set of analyses conducted was cluster analyses, using the FASTCLUS option. The purpose of this study was to examine the possibility that more than one type of site location pattern is manifested in the site data. The FASTCLUS procedure is particularly well suited for this assessment because it can manipulate a very large number of cases (up to 100,000). Other cluster programs, although providing more information concerning the clusters and behaviors of the variables, cannot handle more than 250 cases. Since there are 279 cases (sites) currently in the data base, and several hundred more were anticipated to become available for study following the Class II survey, the FASTCLUS option was deemed to be more appropriate.

Cluster analysis basically involves a series of matrix functions which compare the relative similarities of value combinations for all variables being examined, and divides the data set into subsets (clusters) which are highly similar to each other. Since all variables being monitored were continuously distributed, limits were placed on the number of clusters that could be generated, for the odds that substantial numbers of sites would share the exact same values for all seven variables were very low. The cluster program was run several times. The cluster limit was reduced with each successive analysis. The clustering procedure was stopped when:

1. The number of sites in each cluster was highly nonrandom among the clusters.

2. When it was felt that further reductions in the number of clusters the program was allowed to make would mask real location patterns in the data.

Other than setting limits on the number of clusters to be made, the data were not treated in a biased fashion. Previous studies in the region do not provide any overwhelmingly compelling reasons for dividing the data base into cultural/temporal or site type categories prior to analysis. Rather, the approach utilized here was to allow the data to be sorted into clusters based upon site location characteristics to discover how the cultural/temporal, behavioral and regional variables were distributed.

For the first such analysis, the number of clusters the program was allowed to make was set at 55. This number was derived from the number of cultural/temporal categories for the sites in the data base. This number was therefore sufficiently large to capture clustering by cultural/temporal membership, if such a tendency existed in terms of site location characteristics.

Table 2.1 shows the outcome of this first clustering analysis in terms of cluster membership distribution. As illustrated in this table, several clusters contain relatively large numbers of sites (clusters 11, 33, 36, 52 and 53), indicating that there are significantly large groups of sites which share similar location characteristics. The kinds of sites within the clusters, however, are highly varied in terms of cultural/temporal membership. Inspection of the other archaeological variable, site type, shows similar mixtures of classes within the clusters. There is also little evidence of clustering onto individual topographic maps, indicating that the location characteristics monitored here do not segregate the sites into discrete portions of the study area. The initial analysis, therefore, suggested that there is indeed more than one location pattern in the data and that these patterns crosscut cultural and regional variability.

Table 2.1
Distribution of Membership within Clusters

Cluster Number	Number of Sites	Number of Cultural/ Temporal Classes	Cluster Number	Number of Sites	Number of Cultural/ Temporal Classes
1	5	3	29	3	3
2	1	1	30	2	2
3	8	6	31	5	4
4	4	2	32	1	1
5	3	2	33	20	8
6	8	4	34	3	2
7	7	7	35	7	4
8	2	2	36	13	5
9	2	1	37	9	3
10	1	1	38	8	6
11	20	13	39	5	2
12	2	2	40	2	1
13	4	2	41	3	3
14	1	1	42	5	3
15	3	1	43	7	3
16	3	2	44	1	1
17	2	1	45	5	2
18	1	1	46	1	1
19	3	3	47	1	1
20	1	1	48	6	2
21	4	3	49	4	1
22	2	2	50	1	1
23	4	2	51	9	5
24	9	7	52	22	11
25	9	4	53	14	4
26	2	2	54	1	1
27	3	3	55	3	3
28	6	4			

A second cluster analysis was conducted with the number of clusters permitted set at 20. This limit was set on the basis of the site frequency distribution among the 55 clusters. A total of 35 clusters contained six or fewer sites, indicating that if the site assemblage was forced into fewer clusters, real and significant differences in site location patterning would become much more apparent. A summary of cluster membership distribution among the 20 clusters is shown in Table 2.2. This table further confirms that membership in the various sets of site location values are not evenly distributed among these data. Seven of these clusters (clusters 3, 5, 6, 10, 14, 17 and 20) include large number of sites. In fact, this set of clusters contain 218 or 77.6% of all the sites in the data base. This patterning suggests that among these data there are a relatively small number of location variable value sets which describe where sites are likely to occur. Again, an inspection of the archaeological and topographic map variables indicates that each of these clusters contains a wide variety of cultural/temporal, site type and regional classes of sites.

Table 2.2
Site Frequencies by Cluster

Cluster Number	Number of Sites	Cluster Number	Number of Sites
1	5	11	3
2	1	12	3
3	24	13	5
4	4	14	47
5	47	15	7
6	33	16	1
7	11	17	25
8	9	18	4
9	2	19	8
10	17	20	25

The major clusters of sites generated by the FASTCLUS program were then used as site location types and were subjected to discriminant function analysis. The purpose of this analysis was to discover:

1. How the seven location variables operate in terms of distinguishing clusters from each other,

2. The relative strength with which each variable contributes to each cluster's model of site location,

3. How distinctly different each location model is from the others.

A stepwise discriminant function analysis program (STEPDISC) was used to perform these analyses. In discriminant analysis, the variables which appear to differentiate the clusters from one another are combined into a multivariate equation and weighted to minimize within-cluster variation and maximize between-cluster variation. That is, each cluster is literally forced to be as statistically distinct from the others as possible.

The stepwise procedure selects only those variables which significantly contribute to between-group variation. The result of this analysis is a series of site location models and the completion of the initial model development phase.

In the stepwise procedure utilized here, the program was instructed to find, in the order of relative importance, the variables which best distinguish between the clustered data. The relative magnitude of the role that each variable, in combination with the others, plays in distinguishing its group from the others was also measured. The results of this analysis are presented in Table 2.3. As shown by this table, distance to water is by far the most important variable in cluster formation and in distinguishing between groups. The variables, listed in their order of importance, are presented in Table 2.3.

Table 2.3
Stepwise Discriminant Function Summary for Site Clusters

Step	Variable	F-statistic	Prob.>F	Prob.>Lambda
1	distance to water	319.50	.0001	.0001
2	view spread	35.44	.0001	.0001
3	local relief/brokenness	33.94	.0001	.0001
4	aspect	28.76	.0001	.0001
5	overlook	5.09	.0001	.0001
6	slope	3.27	.0001	.0001
7	drainage rank	1.88	.0161	.0001

Statistical measures presented in Table 2.3 show that all variables are highly significant in discriminating within-cluster from between-cluster variation. The F-statistic is a ratio which measures between-group:within-group variance. This statistic shows more clearly the relative importance of the role that each variable plays in contributing to the separate identity of each cluster. As shown in Table 2.3, distance to water plays the most important role in distinguishing the clusters from each other and drainage rank is the least important factor in describing distinctively different site settings among the clustered data. The probability that between-cluster variance exceeds within-cluster variance is calculated for each variable in Table 2.3. Thus the odds that the F-ratio for the distance to water values among the clusters was caused by chance alone (i.e., is random) is greater than one in 10,000.

Another statistic, Wilks Lambda, measures the discriminating power of each variable in the functional equation. That is, this measure assesses the amount of variation remaining in the data for a given variable after that variable entered the equation. As shown in Table 2.3, very little variation could not be accounted for after the weighting coefficient had been calculated for each set (cluster) of data. Thus the variables selected in the stepwise analysis are highly suitable for developing powerful models. Both statistics show that all variables are highly significant. It is therefore clear that the groups of sites represent distinctly different location types.

These groups were then examined with another discriminate function analysis designed to develop a formal location model for each cluster and to test the strength of the models in accurately classifying the sites into their appropriate group. Two clusters (clusters 2 and 16, see Table 2.2) were eliminated from modeling since they contain only one site each. A total of 18 models was therefore developed.

These models are expressed in the form of the discriminate function equation:

$$D_j = K + d_{j1}X_1 + d_{j2}X_2 + \ldots . d_{jn}X_n$$

Where: D_j is the score of the discriminant function j
K is a weighted constant
d is the weighting coefficient for the variables X_1, X_2, etc.

These scores can be used to assess whether a locus belongs to a particular site location group or with what exact probability a given locus can be assigned group membership; thus the scores can be utilized for management purposes.

An initial internal test of the 18 models was performed. In this test, the data were monitored by each of the discriminant functions and were reclassified into groups in terms of goodness of fit to a particular model. This test is designed:

1. To assess how discrete or distinct the models are from each other.

2. To examine the values of the seven variables on a site-by-site basis to determine whether the models can accurately "recognize" members of the different groups.

The results of the reclassification study are given in Table 2.4. As clearly shown in this table, reclassification accuracy is extremely high; much higher, in fact, than one would expect given the variability in site locations exhibited in these data. Based upon these results Kemrer and Kearns (1982:54) concluded that it was highly likely that these models accurately depict real and distinctive site location patterns in the Abo region.

A number of activities related to model refinement and testing were planned subsequent to the completion of Phase II, the sample survey. First, the survey would be useful for assessing the utility of the location variables employed in this initial modeling effort. The opportunity for discovering and using new or revised variables to refine the models was also allowed.

Second, it was unknown how the previously recorded site data in the archaeological data base were biased. Thus the data from the Class II survey would be important for gauging representativeness. This was a consideration taken into account during the Phase I efforts. The number of models initially developed was purposely left at 18, a relatively large number, for it was unknown whether the distribution of site frequencies among the clusters was

truly reflecting differential preference for the various site settings depicted by the models. Again, the data from the sample survey were considered instrumental for assessing differential site location preference and selecting the most appropriate number of models for the Abo study area.

Table 2.4
Reclassification Analysis of the Site-specific Location Data

Cluster Number	Number of Sites in Cluster	Number of Sites Correctly Classified	%	Number of Sites Misclassified	%
1	5	5	100.0	0	0
3	24	23	95.8	1	4.2
4	4	3	75.0	1	25.0
5	47	41	87.2	6	12.8
6	33	30	90.9	3	9.1
7	11	7	63.6	4	36.4
8	9	8	88.9	1	11.1
9	2	2	100.0	0	0
10	17	10	58.8	7	41.2
11	3	3	100.0	0	0
12	3	3	100.0	0	0
13	5	5	100.0	0	0
14	47	47	100.0	0	0
15	7	7	100.0	0	0
17	25	25	100.0	0	0
18	4	4	100.0	0	0
19	8	8	100.0	0	0
20	25	21	84.0	4	16.0
TOTAL	279	252	90.3	27	9.7

Third, another set of test data was to be developed from locations which were archaeologically surveyed, but where no sites were found. These loci were to be encoded and treated analytically in the same fashion as the site data. These data would be used to assess and refine the "nonsite" concept (cf. Larralde and Chandler 1981); that settings where sites are not likely to occur do exist and can be defined within the Abo study area. Activities that were contemplated included analysis by the discriminant function equations to evaluate "nonsite" recognition as "site" loci and with what degree of probability. If "nonsite" settings in fact exist, then their locational characteristics would be taken into account and modeled.

The Phase III model testing and refinement activities proposed by Kemrer and Kearns (1982) were implemented. The outcomes are documented in Chapter 4 of this report.

2.3 IDENTIFICATION AND SUMMARY OF PHASE II SAMPLING STRATEGY AND FIELDWORK

Phase II of the Abo Archaeological Project was designed to field test the locational model generated during Phase I. The Phase II survey was also intended to furnish additional data concerning the variability and density parameters of the cultural resources within the study area. The survey consisted of a surface reconnaissance conducted within the confines of a contiguous sample area of approximately 189 square miles. The sample area is located entirely within Chaves County, New Mexico, and includes Township 4S, Ranges 21 through 25E; Township 5S, Ranges 21 through 26E; Township 6S, Ranges 22 through 27E; Township 7S, Ranges 22 through 27E; Township 8S, Ranges 22 through 26E; Township 9S, Ranges 22 through 26E. The sampling area was defined by BLM and represents roughly 31% of the original "model universe". It is situated north of Roswell, New Mexico and south of the De Baca County line (Figures 1.1 and 1.2).

The size of the sample area (roughly 636,057 acres) and the mixed land jurisdiction within it precluded a complete inventory survey. Consequently, a sampling program was formulated to examine a representative portion of the sample area. Sampling was restricted to those lands within the study area currently under the surface ownership of BLM. This includes approximately 250,941 acres which are widely and irregularly distributed throughout the sample area. The size of the survey was constrained by funding and was therefore set at 12,000 acres. This represents roughly 4.8% of the BLM administered lands and roughly 1.9% of the sample universe. The sampling design consisted of a stratified random sample of 80-acre quadrats. As noted in the ESCA-Tech Corporation proposal (ESCA-Tech 1982:28), it was anticipated that the sample survey data would reveal a range of variability somewhat different than the extant data indicated, and that subsequent refinement of the initial model would be required. The quadrat size of 80 acres was chosen since (1) a one-quarter by one-half mile configuration facilitates cadastral control, (2) this type of quadrat has been used in earlier surveys with sufficient success, and (3) given the sample size of 150, the total area to be surveyed (12,000 acres) would be comparable to BLM

sponsored Class II surveys of similar scope and purpose. Also, if the predictive goals of the project proved ineffective, a sample size of 150 should nonetheless have proven sufficient for achieving at least reasonable first approximation assessment of the cultural resources population parameters.

As noted, the BLM administered lands within the study area are not evenly distributed. Therefore, a hierarchical stratification scheme was developed to maximize evenness of sample coverage within the study area. The study area was initially stratified by townships, then by sections within townships, and finally by 80-acre quadrats within each section. There are 32 townships within the sample area. All except two of the townships contain at least two and three-quarters sections of BLM (surface) administered land. The two exceptions contain one half section and slightly over one and one-half sections of BLM administered land. The smaller value, while close to the cut-off point for inclusion in the sample design, was nonetheless considered to be within acceptable limits for inclusion. One hundred fifty quadrats were selected from the 32 townships. The sample was therefore nested and included four quadrats randomly selected from each township plus an additional three quadrats randomly selected from block units of four townships each.

The purpose of this approach was to maximize spatial coverage within the survey area. By using the stratified townships strategy, the sample was evenly distributed throughout the sample area despite land jurisdiction. In this manner, control was also maintained for the range of environmental diversity within the sample area. This is an important consideration. There is greater environmental diversity manifested in the study area from west to east than from north to south. For example, each of a series of transects from west to east would typically encounter the limestone hills, loamy gyp uplands and sandy plains of the Sacramento Plain and the Diamond A Plain, the Pecos River terraces, and the dissected Mescalero Pediment east of the river. A transect from north to south could conceivably have remained within a single environmental zone (e.g., the limestone hills or the Mescalero Pediment). The setting crossed would depend on the longitudinal orientation of the transect.

Uniformity in the examination of the range of environmental settings was ensured by maximizing the distribution of sample quadrats throughout the sample area. For instance, the greatest amount of BLM administered lands is confined to the western one-third of the sample area. If a simple random sample from an unstratified selection of quadrats under BLM jurisdiction had been used, there was a high probability that the western third would be overrepresented in the sample and the remaining areas underrepresented. This is particularly true for those lands adjacent to the Pecos River, in the northeast portion of the study area, and in the center of the study area east of Highway 285. Given the environmental diversity among these areas, it was imperative to provide for adequate coverage.

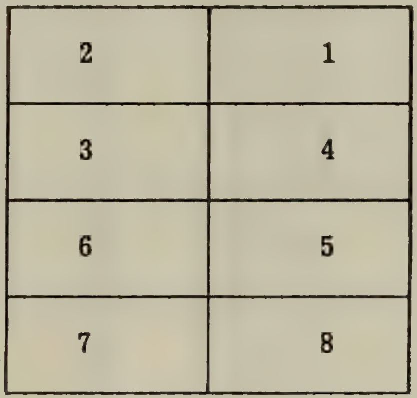
The sample was stratified by township rather than by specific environmental variables due to the incomplete knowledge of the distribution of those variables. Several avenues for stratifying the sample area by environmental variable were examined. These included soil and vegetation distributions, physiography, geological setting, and climatic data. These variables were not

used for the sampling design for a variety of reasons including the incomplete or nebulous data available for some variables, the generalized distribution of other variables and the overly numerous strata which would be generated by others. Environmental variables were not ignored. Rather, the stratified township approach allowed us to examine as wide a range of environmental settings as necessary to ensure adequate coverage.

Also, comparison of the available mapped environmental values with observed values from surface reconnaissance of the sample area was necessary to adequately assess the feasibility of projecting various environmental values throughout the model area. Maximizing coverage facilitated this goal. The maximum coverage provided by using the stratified township design also provided greater reliability for determining the distribution of various cultural phenomena within the sample area. The results obtained through the use of the stratified township design are compatible with the goal of testing and refining the location model developed for the project area.

The 80-acre sample units are rectangular, measuring 1/4 mile by 1/2 mile. Since environmental variation within the sample universe is greater from east to west than north to south, all units were oriented with their long axes oriented east-west in order to capture as much intraunit environmental variability as possible. The sample units were spatially registered with the township-range-section land partitioning system. Thus the units correspond to the N1/2 or the S1/2 of regular quarter section of land. For sample selection purposes, each section of land was partitioned into eight sample units and numbered as shown in Figure 2.1.

Figure 2.1
Schematic view of a Section of Land Partitioned
into Sample Units



2	1
3	4
6	5
7	8

The sample unit numbering system corresponded to legal descriptions. Thus sample unit 6-24-3-8 is located in Township 6 South, Range 24 East in Section 3, and is the southern 1/2 of the SE1/4 of that Section. A listing of the 150 sample unit numbers inventoried within the Abo study area ordered by township is presented in Table 2.5.

Table 2.5. Listing of the Abo Sample Units

No.	Sample Unit	No.	Sample Unit	No.	Sample Unit
1	4-21-10-7	51	5-26-31-8	101	7-25-29-5
2	4-21-14-6	52	6-22-4-8	102	7-26-15-8
3	4-21-18-8	53	6-22-7-6	103	7-26-18-4
4	4-21-21-1	54	6-22-20-6	104	7-26-27-7
5	4-21-23-5	55	6-22-31-4	105	7-26-31-6
6	4-21-23-8	56	6-22-33-3	106	7-26-34-7
7	4-21-29-4	57	6-23-6-7	107	7-27-20-2
8	4-22-17-6	58	6-23-10-4	108	7-27-31-7
9	4-22-20-7	59	6-23-18-7	109	8-22-5-6
10	4-22-30-3	60	6-23-31-4	110	8-22-12-2
11	4-22-31-5	61	6-24-22-3	111	8-22-17-4
12	4-23-18-3	62	6-24-26-7	112	8-23-15-4
13	4-23-18-6	63	6-24-26-8	113	8-23-17-3
14	4-23-33-5	64	6-24-27-7	114	8-23-18-5
15	4-23-33-7	65	6-24-33-2	115	8-23-18-7
16	4-24-12-1	66	6-25-1-1	116	8-23-19-7
17	4-24-12-2	67	6-25-3-2	117	8-23-22-3
18	4-24-12-3	68	6-25-22-7	118	8-23-31-4
19	4-24-12-4	69	6-25-27-2	119	8-24-10-3
20	4-25-1-4	70	6-25-31-7	120	8-24-11-1
21	4-25-3-7	71	6-25-33-7	121	8-24-13-7
22	4-25-5-6	72	6-26-7-6	122	8-24-14-7
23	4-25-17-4	73	6-26-15-7	123	8-24-24-3
24	4-25-31-5	74	6-26-31-8	124	8-25-11-3
25	5-21-6-8	75	6-26-33-8	125	8-25-12-4
26	5-21-10-7	76	6-27-7-8	126	8-25-18-7
27	5-21-12-5	77	6-27-19-6	127	8-25-25-4
28	5-21-26-4	78	6-27-20-6	128	8-26-24-1
29	5-21-33-1	79	6-27-28-7	129	8-26-32-1
30	5-21-35-6	80	7-22-8-2	130	8-26-33-5
31	5-22-5-4	81	7-22-19-4	131	8-26-35-7
32	5-22-6-5	82	7-22-24-5	132	9-22-3-5
33	5-22-9-1	83	7-22-26-7	133	9-22-9-1
34	5-22-16-3	84	7-22-33-2	134	9-22-12-3
35	5-22-29-1	85	7-23-6-1	135	9-22-24-2
36	5-22-30-6	86	7-23-6-8	136	9-23-7-3
37	5-23-4-7	87	7-23-8-2	137	9-24-1-8
38	5-23-14-7	88	7-23-8-6	138	9-24-12-1
39	5-23-23-4	89	7-23-20-1	139	9-24-12-3
40	5-23-34-5	90	7-24-23-8	140	9-24-24-1
41	5-24-15-1	91	7-24-24-8	141	9-25-8-3
42	5-24-23-1	92	7-24-26-1	142	9-25-14-3
43	5-24-25-6	93	7-24-26-8	143	9-25-18-6
44	5-24-28-6	94	7-24-35-5	144	9-25-22-2
45	5-25-4-2	95	7-25-3-2	145	9-25-24-8
46	5-25-9-2	96	7-25-3-8	146	9-25-25-8
47	5-25-21-1	97	7-25-4-6	147	9-25-31-1
48	5-25-24-6	98	7-25-22-4	148	9-26-3-5
49	5-25-27-5	99	7-25-25-7	149	9-26-3-7
50	5-25-34-4	100	7-25-29-4	150	9-26-4-7

The location and distribution of the sample units is illustrated in Figure 1.2. As evident in this figure the stratification system created a relatively even distribution of sample quadrats throughout the study area.

2.3.1 Phase II Field Implementation

The Abo Project fieldwork commenced on June 6, 1983 and continued until August 10, 1983. Abo field personnel included Timothy Kearns and Kenneth Lord as crew supervisors, with Phillip Condrey, Karen Diver, John (Chuck) Haight, Hoskie Schaafsma, Richard Sullivan and Dennis Yazzie as crew members. Dr. Meade Kemrer (Principal Investigator) was in the field for the initial 10-day session. Ann Ramage (District Archaeologist) joined the crew for three half days, and Pegi Jodry (visiting archaeologist) participated for several days during the second field session. Nancy Hewett Cella was based at the CCP Albuquerque office and served as research assistant during the fieldwork phase.

Fieldwork was conducted in a series of five 10-day sessions separated by four-day breaks. Typically, two survey crews of four persons each formed the field team. Occasionally, crew size was modified in response to situational demands. These exceptions included occasions when an individual survey crew was composed of three, five or six members. A crew supervisor was always present with each field crew. A total of 364 person days were required to complete the survey of the 150 randomly selected 80-acre sample units. Thus an average of 2.42 person days was spent on each sample unit.

The field procedures for each sample unit began by locating it on the ground by using USGS 7.5' topographic maps. Section markers, where available, were used to define sample unit corners. If section markers were not found, compass triangulation from prominent landmarks (often well pads) was employed. Once a unit corner was located, the crew supervisor established the transect orientation by compass bearing. The crew spread out along this line and commenced surveying the unit by walking parallel linear transects. Ideally, spacing between crew members averaged 20 meters as a maximum distance. However, in some instances spacing varied from 10 to 40 meters, depending on terrain and vegetation. Compass bearings were utilized to maintain proper orientation, and the person on the outermost edge of the transect would mark the line with pin flags. The flags were then retrieved on the return transect. The transect procedure was repeated until the entire quadrat had been surveyed. Since the long axis of the sample units were oriented east-west, the transects were oriented parallel to that axis.

Modified survey procedures were employed in situations where topographic relief was great or where a physiographic feature inhibited use of straight linear transects. Contour transects were employed in complex terrain and in situations where cliff-bound canyons or steep unconsolidated slopes occupied portions of a sample unit. In these areas, the more level portions (mesa or ridge tops, canyon and valley floors, benches and steps) were examined using parallel linear transects, contour transects or a combination of both. The unconsolidated talus slopes and cliffs were examined where access and safety permitted. Whenever possible, an effort was made to examine those

areas generally termed wasteland or often subjectively eliminated as too rugged, unconsolidated or undesirable for human occupation or use.

Ideally and generally, a four-person crew was used to survey a sample unit. A four-person crew required an average of four transects to complete one quadrat. Thus each member walked an average of two miles to cover a single unit.

When a cultural resource was discovered, its character (i.e., site, isolate) and perimeter would be defined and the crew supervisor would plot the location on the appropriate USGS topographic map. If designated a site or field locus, the survey team would conduct closely spaced (2 - 5 meters) transects across the site area, to identify concentrations or loci and would mark each artifact with a pinflag. Where the flake density precluded marking individual flakes, only tools or implements and concentrations of flakes were flagged. Recording duties were then delegated to individual team members. These included preparing the site map, qualification and quantification (often using sample transects) of the assemblage, drawing diagnostic artifacts, photographing artifacts and the site, and completing the New Mexico Laboratory of Anthropology site form. No site markers or other indicators were left at the sites following completion of the recording tasks.

A non-collection policy was followed for all artifacts. It was decided that illustrations and photographs of diagnostic artifacts, coupled with written descriptions, would be adequate for the purposes of identification at the Class II survey level.

Assemblage recording included estimating as accurately as feasible the number and diversity of artifacts present at a site as well as their spatial distribution. Where the total number of artifacts was somewhat limited (e.g., fewer than 50 to 100 specimens) an effort was made to record and map each item. Where the number and diversity was greater, a sampling strategy was employed. This sampling strategy was also somewhat stratified. That is, in situations where the total number of modified artifacts or tools was limited but where there was a relative abundance of flake debris, all the tools were documented and a sample transect or transects was employed to monitor flake density and diversity. In other instances, where the total number of modified artifacts or tools as well as flake debris was substantial, sample transects were used to monitor the density and diversity of both tools and flakes (Figures 2.2 - 2.4).

Modified artifacts or tools were recorded on an artifact record form (Figure 2.5). Typically this included a brief description emphasizing the morphological and modification attributes of each specimen (e.g., marginally retouched secondary flake uniface, unifacially ground and pecked unshaped cobble handstone, edge battered cobble uniface), followed by size and material attributes and functional information or additional comments (e.g., steep edge side scraper, well used handstone, angular hammerstone with corners and edges heavily battered).

Figures 2.2, 2.3 and 2.4

Sample Unit 7-26-18-4

This sample unit is located primarily on the Blackdom Terrace overlooking the Pecos River, and partially on the lower Orchard Park and Lakewood Terraces. Site LA 44882 is an extensive lithic procurement-workshop site (Type 3A) which corresponds to the distribution of exposed gravels on the Blackdom Terrace. This site was sampled by two methods: transect sampling and locus sampling (see Figure 2.3). Site LA 44883 (Figure 2.4) is a relatively small sherd and lithic scatter (Type 2A) situated on the sand capped portion of the Blackdom Terrace. Note its spatial segration from the gravel deposits and site LA 44882. Also note the manner in which the isolated occurrences tend to "feather-out" away from the primary use area of LA 44882.

Figure 2.2
Sample Unit 7-26-18-4

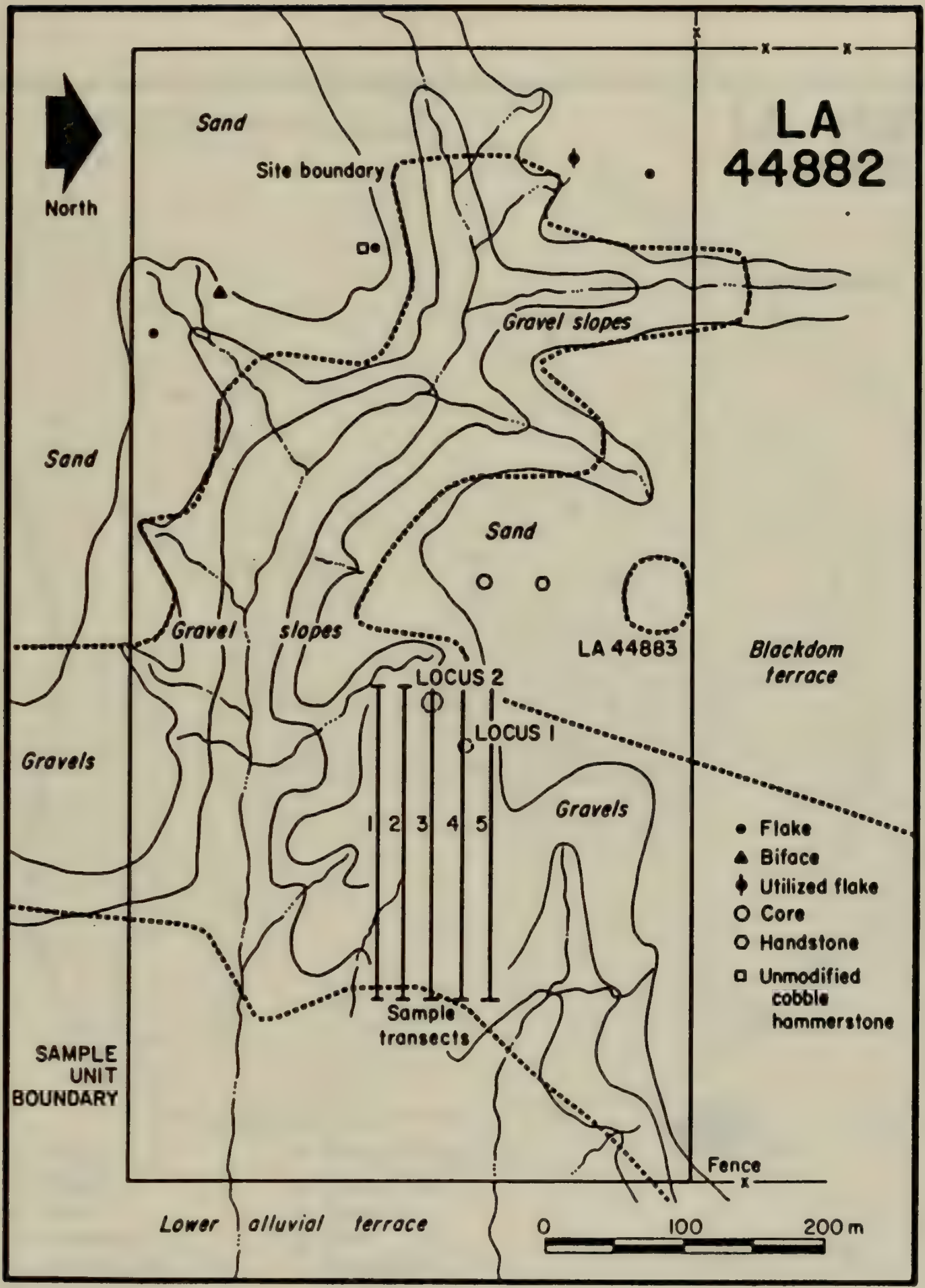


Figure 2.3. LA 44882, Sample Locus 2

This is an example of a concentrated occurrence of flakes and tools that occur within the extensive lithic procurement-workshop sites (Type 3A). It represents an example of locus sampling.

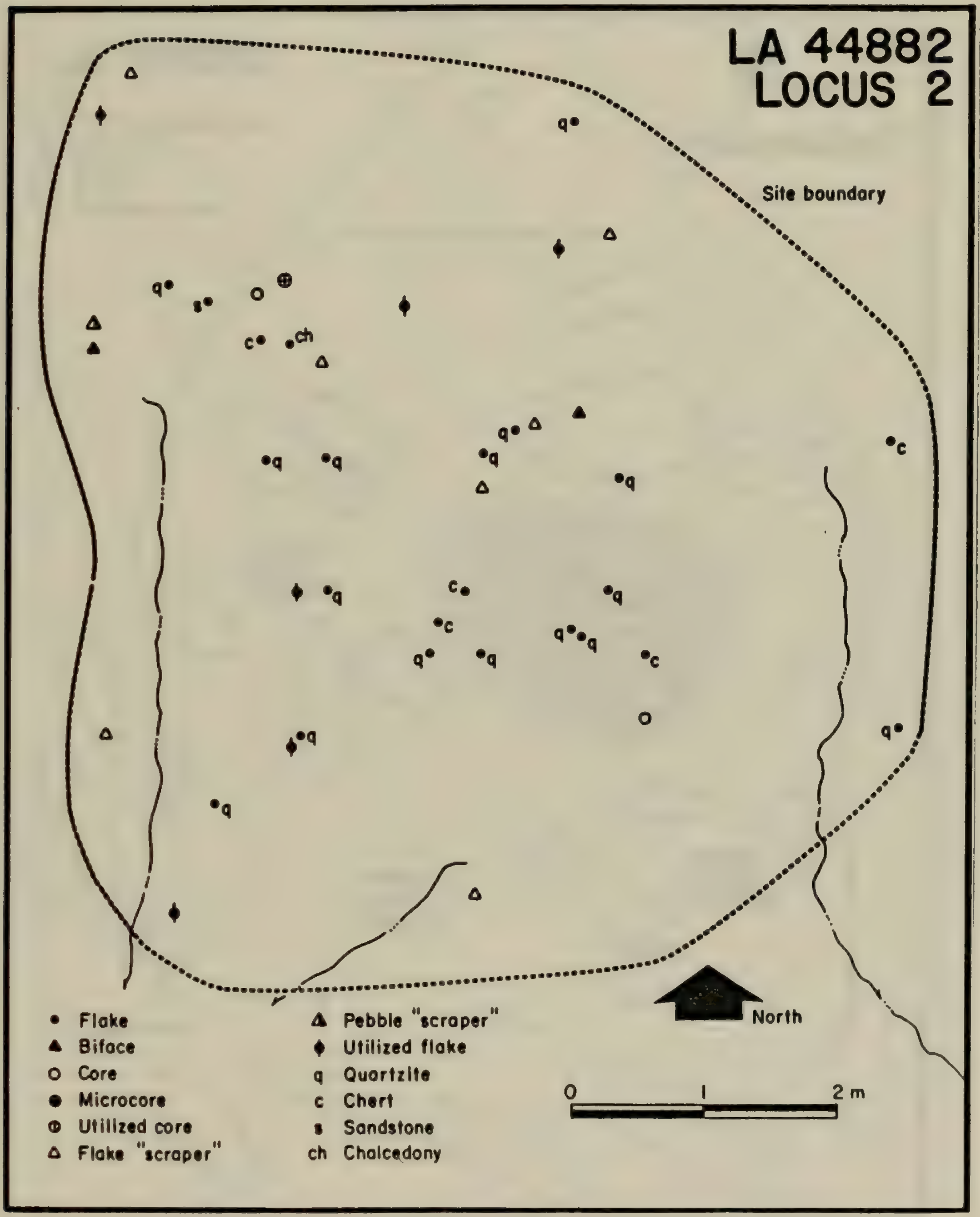
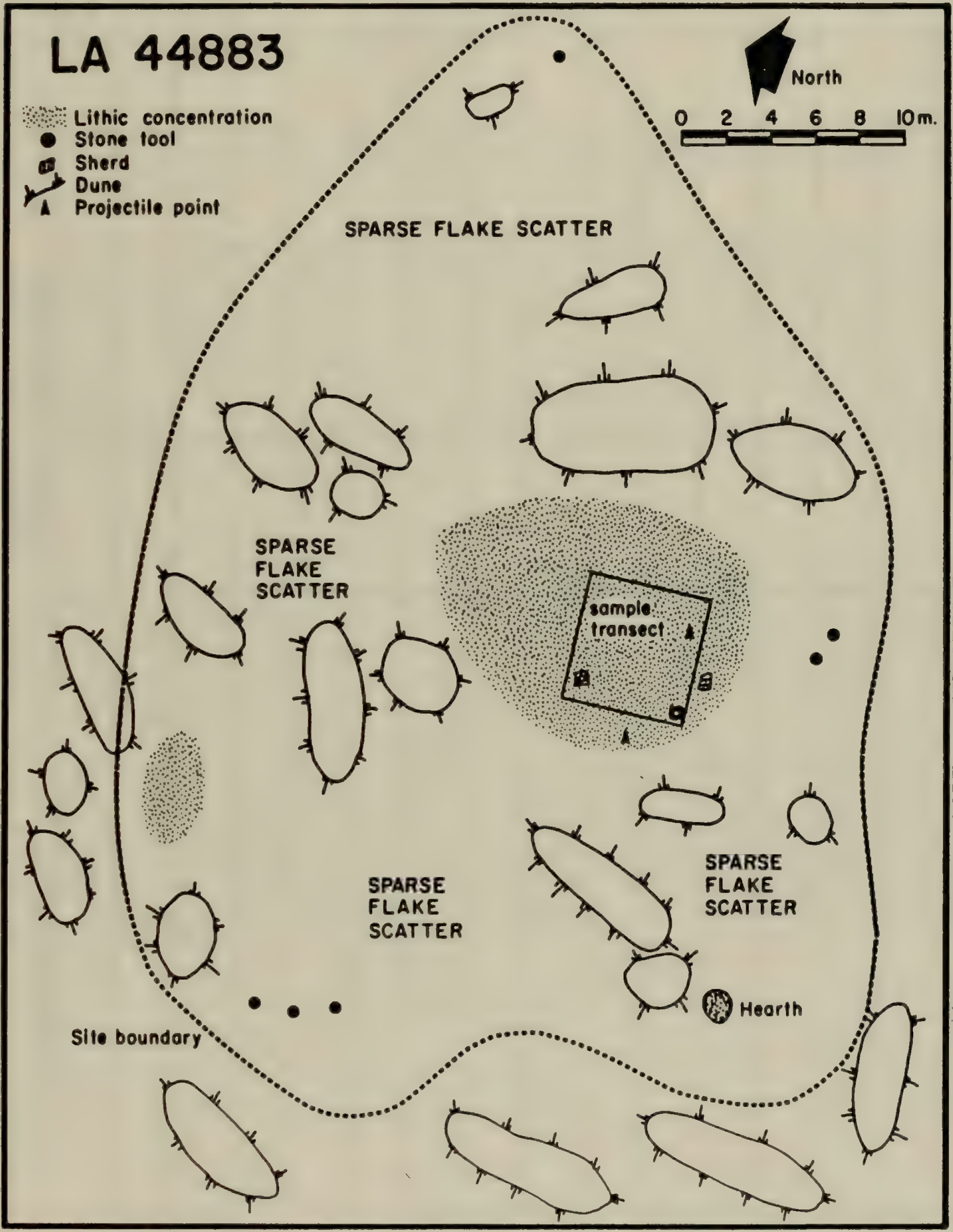


Figure 2.4
LA 44883, A small Type 2A temporary camp locale.

Note the spatial segregation of the artifact concentrations and the hearth feature. The flake debris at this site was sampled by a sample transect located in the densest area of the site. All tools were identified.



ARTIFACT RECORD FORM

Project ____________________

IO/Site # ____________________

Provenience ____________________

Recorder: ____________________

Date: ____________________

Artifact #	Type/Description	Check if Drawn	Size (cm)	Material	Functional information and comments

Figure 2.5

Ceramics were monitored on another form (Figure 2.6). An effort was made to identify the ceramic type and vessel form for each sherd. Further, information regarding paste, temper, surface finish and decoration attributes of the sherds was generally obtained. This latter information was more specifically documented when the type designation was questionable or undetermined.

The flake debris was monitored on an unutilized debitage form (Figure 2.7). This included identification of the flake type (e.g., primary decortication, tertiary trimming, tertiary biface reduction, hammerstone spall) in combination with size and material attributes.

Features, when encountered, were recorded on the site form or, if particularly abundant, on a separate sheet. Documentation typically included a brief description of the type, size, configuration and content of each feature.

When single, spatially isolated artifacts were encountered they were assigned an isolated occurrence designation, recorded on a specific form (Figure 2.8), located on the topographic map and drawn or photographed if warranted. Often two or more artifacts were noted as an isolated cluster or in relatively close proximity. These were identified as field loci and were recorded in a similar manner as the isolated artifacts. In these latter instances where several specimens were present, an effort was made to map or otherwise record the spatial relationships between the artifacts.

The sites, field loci and isolated artifacts are viewed as a continuum of regional land use. Thus the distinction between a site and field locus was at times somewhat arbitrary, necessitating a subjective field decision. This was particularly true in those situations where the erosional or depositional characteristics of a particular locale or the vegetative cover hampered adequate evaluation of resource content or integrity. Generally, a cultural resource was assigned site status if there were 10 or more artifacts within a spatially definable area of reasonable dimensions. There were exceptions to this general rule. As noted above, the erosional, depositional and ground visibility characteristics of a particular locale tempered the decision to record it as a site or field locus. When a cultural resource was identified as a field locus sufficient information regarding the physiographic setting, depositional or erosional characteristics, vegetation and spatial relationships of the artifacts was recorded to enable changing it into a "site" if further investigation indicated that necessity.

During the survey sessions, the crew camped in the field at locations which allowed relatively easy access to groups of sample units. Meals were prepared communally and general camp maintenance duties were systematically shared among the crew. One half-day in the middle of each 10-day period was reserved for stocking food and supplies, showers, laundry, and for organizing notes.

Much of the BLM administered land in the study area is leased to local ranchers. Therefore, an effort was made to contact the leasees prior to surveying the sample units. This was accomplished either by phone or by visiting individual ranches.

CERAMIC SUPPLEMENT FORM

Project: ______________________

Site #: ______________________

Unit of Analysis: (site, locus, feature, sample transect) ______________________

Dimensions: ______________________

Recorded: ______________________

Date: ______________________

Estimated % (site/locus) __________ / __________

Type	Vessel Form				Paste		Temper		Surface finish	Decoration
	bowl	jar	other*	indet.						

Figure 2.6

* List

UNUTILIZED DEBITAGE RECORD FORM

Project:________________
Site No.:________________
Unit of Analysis: (site, locus, feature, sample transect)________________
Dimensions:________________

Recorder:________________
Date:________________

Estimated % (of site/locus)________________

MATERIAL TYPE/SIZE*

Debitage Type															
	Lg.	Md.	Sm.	Lg.	Md.	Sm.	Lg.	Md.	Sm.	Lg.	Md.	Sm.			
Primary Decortication															
Secondary Decortication															
biface reduction															
uniface/scraper resharpening															
cobble tool resharpening															
hammerstone spall															
Tertiary/ Interior															
biface reduction															
minute (1cm) retouch															
uniface/scraper resharpening															
other resharpening															
hammerstone spall															
channel															
Angular shatter															

Comments: note flaking techniques (i.e., hard hammer, soft hammer), platform preparation (i.e., ground, crushed, faceted), etc.

Figure 2.7

*Large - 5 cm.; Medium - 3-5 cm.; Small 1-3 cm,; ______ cm. - small retouch flakes

Figure 2.8

ISOLATED OCCURRENCE FORM

Page 1 of 2

Project:______________ District:______________ Sample Unit:____________

Location: T_____, R____, ____¼ of ____¼ of ____¼ of Section _______

Quadrangle:______________________, UTM: _______________ __________________

Physical Setting: (Topography, soils, drainage, and any characteristics of the setting that may be pertinent, e.g., availability of lithic resources, shelter, view)

Vegetation: (Describe floral community)

Description: (follow procedure established for artifact recording)

Size:

Material:

Recorded by:
Date:

Photos _______________

Figure 2.8 (continued)

Field Locus/Isolated Occurrence Page 2 of 2

MATERIAL TYPE

Debitage Type	Lg.	Md.	Sm.	Lg.	Md.	Sm.	Lg.	Md.	Sm.

Follow same format as for recording debitage at sites

IO #

Scale: Drawn by:

Note: The upper matrix can be used in instances where more than a single artifact is present.

Chapter 3

ANALYSIS OF ARTIFACTS AND SITES

3.1 INTRODUCTION

The Abo Archaeological Project survey (Phase II) examined 150 80-acre sample units (12,000 acres) in Chaves County, New Mexico. The survey resulted in the recording of 120 newly discovered sites within the sample units plus another site located immediately adjacent to a sample unit. Although 15 previously recorded sites were, according to BLM site records, supposed to occur within the sample units, two were apparently mislocated for only 13 were found. Among these, one was eliminated from subsequent analyses in this report because of its minimal significance (a post-1940 Anglo trash scatter). A total of 521 isolated cultural occurrences were also recorded by the sample survey. The following sections present a summary of the cultural resources encountered. Included is a discussion of the variability inherent in the cultural resources and a summary of the methodology and rationale for identifying site types. Since the site typology is based primarily on assemblage characteristics, the initial discussion will address the analyses of specific artifact classes and features. A discussion of the site type classification scheme is then presented. This is followed by a discussion of the cultural-temporal variability documented for the cultural resources.

3.2 ARTIFACT VARIABILITY

Artifacts are identified as portable objects evidencing modification by human agency. Artifacts encountered during the Abo project fall into four major categories: ceramics, flaked or chipped stone, battered stone, and ground stone. In addition, several items were encountered which represent another artifact category: worked shell. The following section addresses the occurrence and variability within each of these categories.

3.2.1 Ceramics

Ceramics are traditionally one of the most important cultural and temporal indicators utilized in Southwestern archaeology. A total of 23 prehistoric sites (19.16%) discovered during the Abo project survey contain ceramics in their assemblages. In addition, four of the 11 previously recorded prehistoric sites include ceramics and six of the isolated occurrences are represented by ceramics. Tables 3.1 and 3.2 summarize the ceramic data for the Abo project sites.

Two major categories of ceramics are represented in the Abo project sites: brownwares and graywares. Both wares are related to previously described ceramics from southern New Mexico. The brownwares are related to the Jornada Brown of southern New Mexico Mogollon origin. The graywares are related to the Chupadero Black-on-white wares of southern Anasazi origin.

Table 3.1
Summary of Ceramics Encountered During the Abo Project Phase II Survey

Site Number	Estimated % of Site *	Ceramic Types	Vessel Forms
LA 44858	90%	Jornada Brownware (14) **	Bowl (9) , Jar (5)
		Jornada Red-on-brown (2)	Bowl (2)
LA 44859	25%	Chupadero Black-on-White (37)	Bowl (17), Jar (20)
		Crosby Black-on-gray? (1)	Bowl (1)
		Jornada Brownware (8)	Bowl (5), Jar (3)
LA 44860	20%	Jornada Brownware (10)	Bowl (6), Jar (4)
		Middle Pecos Micaceous Brown ? (2)	Bowl (2)
LA 44867 (2 loci)	100%	Jornada Brownware (10)	Bowl (4), Undetermined (6)
		Jornada Red-on-brown (4)	Bowl (4)
		Middle Pecos Micaceous Brown (1)	Undetermined (1)
LA 44908	100%	Crosby Black-on-gray (6)	Jar (6)
		Roswell Brown ? (1)	Undetermined (1)
		McKenzie ? Corrugated (7)	Jar ? (7)
LA 44909	100%	Crosby Black-on-gray (2)	Jar (2)
		Chupadero Black-on-white (1)	Bowl (1)
		McKenzie ? Corrugated (5)	Jar ? (5)
LA 44874	60%	Jornada Brown (12)	Jar (11), Bowl (1)
LA 44888	100%	Jornada Brown (3)	Bowl (3)
LA 44880	100%	Chupadero Black-on-white (1)	Undetermined (1)
LA 44883	50%	Chupadero Black-on-white (3)	Bowl (3)
		Jornada Brownware (1)	Jar ? (1)
LA 44884	100%	Chupadero Black-on-white (2)	Bowl (1), Undetermined (1)
		Jornada (?) Brown (1)	Jar (1)

* The approximate percentage of the site area sampled to achieve these sherd counts
** Number in parentheses represent the number of sherds noted

Table 3.1 (continued)
Summary of Ceramics Encountered During the Abo Project Phase II Survey

Site Number	Estimated % of Site	Ceramic Types	Vessel Forms
LA 44885	100%	Chupadero Black-on-white (1)	Jar (1)
		Crosby Black-on-gray ? (1)	Bowl (1)
		Jornada Brown (2)	Bowl (2)
LA 44886	30%	Crosby Black-on-gray ? (2)	Bowl (2)
		Roswell Brown (8)	Jar (8)
		Middle Pecos Micaceous ? (2)	Bowl (2)
LA 44887	30%	Crosby Black-on-gray (3)	Bowl (2), Jar (1)
		Jornada Brown (4)	Bowl (4)
		Jornada Red-on-brown (1)	Bowl (1)
LA 44876	100%	Jornada Brown (1)	Undetermined (1)
LA 45446	100%	El Paso Polychrome ? (4)	Bowl ? (4)
LA 45464	70%	Chupadero Black-on-white (9)	Jar (9)
		Crosby Black-on-gray (8)	Jar (2), Bowl (6)
		Jornada Brown (16)	Jar (16)
		Jornada Red-on-brown (2)	Jar (1), Bowl (1)
		Coarse Jornada Brown (15)	Jar (1), Undetermined (14)
		Middle Pecos Micaceous Brown (14)	Jar (2), Undetermined (12)
		Middle Pecos Micaceous Red-on-brown (2)	Jar (2)
		Roswell Red-on-brown (1)	Bowl (1)
		McKenzie Brown (1)	Undetermined (1)
LA 45480	100%	Jornada Brown (30)	Bowl (30)
LA 45447	25%	Chupadero Black-on-white (1)	Bowl (1)
		Crosby Black-on-gray (1)	Jar (1)
		Middle Pecos Micaceous Brown (3)	Bowl (3)
LA 45448	100%	Chupadero Black-on-white or Crosby Black-on-gray ? (1)	Undetermined (1)

Table 3.1 (continued)
Summary of Ceramics Encountered During the Abo Project Phase II Survey

Site Number	Estimated % of Site	Ceramic Types	Vessel Forms
LA 45459	5%	Chupadero Black-on-white (1) Jornada Brown (24)	Jar (1) Jar (6), Undetermined (18)
LA 45482	100%	Jornada Corrugated (44)	Jar? (44)
LA 45484	2%	Jornada Brown (6)	Undetermined (6)
LA 2531		Jornada Brown (1)	?
LA 2710 **		Unidentified Brown (3)	?
LA 37852 **		Crosby Black-on-gray Roswell Brown	?
LA 34372 **		Chupadero Black-on-white Jornada Red-on-brown	?
Isolate #59		Roswell Brown (10)	Jar (10)
Isolate #65		Chupadero Black-on-white (1)	Bowl (1)
Isolate #116		Chupadero Black-on-white (5) Jornada Brown (1)	Bowl (5) Jar (1)
Isolate #207		Crosby Black-on-gray (10) Three Rivers Red-on-terra cotta (23)	Jar (10) Bowl (23)
Isolate #237		Chupadero (?) Black-on-white (1)	Undetermined (1)
Isolate #447		Crosby Black-on-gray (+)	Jar (+)

** Previously recorded sites

Table 3.2
Summary of Ceramic Types, Sherd Counts, Estimated Number of Vessels Represented and Relative Percentages
(Abo survey site data only)

Ceramic Type	No. of Sites Represented	No. of Sherds	Estimated No. of Vessels	% of Sherd Total	% of Vessel Total
Chupadero Black-on-white	9	56	10	16.42	14.70
Crosby Black-on-gray	8	24	10	7.03	14.70
Jornada Brown	15	142	28	41.64	41.17
Jornada Red-on-brown	4	9	5	2.63	7.35
Coarse Jornada Brown	1	15	1	4.39	1.47
Middle Pecos Micaceous Brown	5	22	5	6.45	7.35
Middle Pecos Micaceous Red-on-brown	1	2	1	0.58	1.47
Roswell Brown	2	9	2	2.63	2.94
Roswell Red-on-brown	1	1	1	0.29	1.47
McKenzie Brown	1	1	1	0.29	1.47
Corrugated	3	56	3	16.42	4.41
El Paso Polychrome	1	4	1	1.17	1.47
TOTALS		341 *	68 *	99.94%	99.97%

* Total minus one undetermined Chupadero Black-on-white or Crosby Black-on-gray specimen

A small number of sherds representing a single vessel are tentatively identified as El Paso Polychrome related to the El Paso Brown of southern New Mexico Mogollon origin. Another small group of sherds (presumably from a single vessel) are redwares related to the Three River Redwares of south-central New Mexico Mogollon origin.

Ceramic identifications were based primarily on Jelinek's (1967:47-87) definitions, the ceramic descriptions and discussion of Hayes (Hayes, Young, Warren 1981:63-73), and on the familiarity of certain crew members with southern New Mexico ceramics. It should be kept in mind that the ceramic data is based on field observation of surface materials only. No ceramics were from excavated context and no collections were made. As a note of precaution, there was a fair degree of difficulty encountered in attempting to identify the Abo ceramics. The relative sparseness of the ceramic assemblages, the general lack of recent ceramic research in the project vicinity, the relatively small size of many of the sherds (often less than 2 to 3cm square), the sand blasted or otherwise eroded condition of some of the sherds, and the general ambiguity or overlap inherent in several of the ceramic types (e.g., Chupadero Black-on-white and Crosby Black-on-gray, Jornada Brown and Roswell Brown) tended to hamper identification. Therefore, the ceramic designations are considered provisional and should be used with caution.

Generally, the number and diversity of sherds noted was rather limited (Tables 3.1 and 3.2). Only three sites (13% of the ceramic sites) have sherd counts (or estimated counts) that exceed 100 specimens. One site has 97 sherds while the rest all contain fewer than 50 sherds. The relative scarcity of ceramics is further emphasized when the total number of vessels represented is estimated (Table 3.2). Only 76 ceramic vessels are estimated to be represented by the Abo sherd assemblage (sites and isolates). The impression gained is that within the study area ceramic production and use was relatively limited. This impression may be skewed somewhat due to depositional and ground visibility factors, or perhaps the limitations imposed by the sample universe. For example, 52.4% of the ceramic sites documented by Jelinek (1967:44-46) in the Middle Pecos Valley contain more than 100 sherds (surface collection data) and 66.7% contain more than 50 sherds.

The diversity of ceramic types is also rather limited. Thirteen ceramic types were recognized during the survey (Tables 3.1, 3.2). This is also in contrast to the results of Jelinek's (1967:60,61) survey in the Middle Pecos Valley where more than 30 ceramic types were identified.

Brownwares represent the most common ceramics (58.9%) encountered during the Abo survey. The majority of these (70.6%) are identified as Jornada Brown. Middle Pecos Micaceous Brown is the next most prominent brownware represented (19.9% of the brownwares) with lesser amounts of Coarse Jornada Brown (7.5%), Roswell Brown (4.5%), and McKenzie Brown (0.5%) also present. In addition, several red painted varieties of brownware are represented including Jornada Red-on-brown (4.5%), Middle Pecos Micaceous Red-on-Brown (1.0%), and Roswell Red-on-brown (0.5%). No effort was made to distinguish the Jornada Brown from El Paso Brownware (Lehmer 1948:94) as the ranges of variation of these two types are not clearly defined and

considerable overlap is evident (see also Jelinek 1967:47; Fenenga 1956:232; Wimberly and Rogers 1977:403). There may be some overlap in the identification of the plain brownwares and the red-on-brownwares. It is conceivable that when both plain and painted sherds are found at a site that they represent a single incompletely painted vessel. Also, the red pigment noted on the survey red-on-brownwares is typically a thin interior wash or a somewhat fugitive (easily weathered) broad-line exterior decoration. It is probable that some red-on-brown sherds may have been misclassified as plain brownwares due to weathering, or incomplete painting on a single vessel. It is also probable that vessel counts are overly represented where brownwares and red-on-brownwares are present at a single site. Brownware vessel forms include both bowls and jars or ollas with the former slightly more common than the latter.

One instance of polychrome decoration was encountered during the Abo survey. Four sherds, presumably representing a single bowl, are tentatively identified as El Paso Polychrome, an intrusive ware of southern New Mexico Mogollon origin. This was the only ceramic type represented at the site and presumably represents an isolated import.

The most common decorated wares are Chupadero Black-on-white (16.42% sherds, 14.7% estimated vessels) and Crosby Black-on-gray (7.03% sherds, 14.7% estimated vessels). Because the distinction between these two wares is relatively fine (Jelinek 1967:54-56) and because Chupadero is not always slipped or scored (Hayes, Young, Warren 1981:67,69) there may be overlap in the sherd identifications. Similarly, some of these sherds may represent Middle Pecos Black-on-white (Jelinek 1967:57-58). The general sparsity of the assemblages coupled with the lack of laboratory analysis negates further refinement. Hayes (Hayes, Young, Warren 1981:68) considers true Chupadero to be intrusive on the Pecos River and citing Jelinek (1967) views the Crosby Black-on-gray and Middle Pecos Black-on-white to be locally made varieties. Vessel forms include both bowl and jars or ollas in roughly equal proportions although there are slightly more Chupadero Black-on-white jar sherds than bowl sherds.

Corrugated ceramics represent 16.42% of the Abo project sherd inventory but only 4.41% of the estimated vessels. The corrugated sherds have been lumped together because of the difficulty of identifying them as one type or another. However, the sherds from LA 44908 and LA 44909 are tentatively identified as McKenzie Corrugated on the basis of quartz, mica and feldspar temper. Those from LA 45482 are tentatively identified as Jornada Corrugated based on a predominance of feldspar temper. It is probable that the three vessels represented are jar forms although some uncertainty exists.

One final ceramic ware, Three Rivers Red-on-terracotta, is represented by 23 sherds found as an isolated occurrence. The sherds presumably represent a single broken bowl. This was associated with a broken Crosby Black-on-gray jar (10 sherds) and 12 flakes.

3.2.2 Flaked or Chipped Stone Artifacts

Artifacts included in this category represent the products and byproducts of percussion and pressure flaking of suitable lithic materials. Two general divisions are recognized: 1) artifacts which represent the residue from chipped stone tool manufacture or maintenance (i.e., flake debris and irregular chipped stone fragments or angular debris); and 2) artifacts which were manufactured by flaking a blank in order to produce a working edge or specific implement, cores from which flakes were obtained, and flake or core tools modified through use only.

The following discussion provides definitions and addresses the variability within the various chipped stone artifacts encountered during the Abo project survey.

3.2.2.1 Flake Debris

This classification represents the discarded residue from stone tool manufacture and maintenance. It includes those flakes which do not exhibit macroscopic evidence of modification or use. Flake debris was common at all of the Abo project prehistoric sites. It is probable that a number of these flakes were utilized for light tasks which did not produce any readily observable wear. Microscopic examination would be necessary to determine the extent to which they may have been utilized. This is necessarily outside the scope of the present investigation. The following definitions were employed to identify the various flake types encountered during the Abo project survey.

3.2.2.1.1 Primary Flakes

These are the initial flakes removed from a core or parent piece of lithic material. There is no prior platform preparation evident and the dorsal face is entirely cortical. Primary flakes were removed to prepare a cobble or stone block for further flake removal (i.e., to create a platform), or were removed to be used as cutting or scraping tools (either unmodified or retouched). Numerous instances of each purpose were documented during the survey. Primary flakes were made from a variety of materials and are presumably indicative of the acquisition of local lithic materials. They vary considerably in size from small (less than 3 cm. long) to large (greater than 7 cm. long) and presumably reflect the size of the parent source material (e.g., pebble, cobble, large or small block).

3.2.2.1.2 Secondary Flakes

These are the flakes removed after the primary flake and before the removal of all the cortical surface from a core or tool. The dorsal face exhibits previous flake scars and a portion of the original cortical surface. Although variable, no effort was made to monitor the differences in the relative amount of dorsal cortex remaining on this flake type. Secondary flakes were removed

as a by-product of core or tool preparation and were produced for use as cutting or scraping tools (either with or without further modification). Instances of both purposes were numerous in the Abo site assemblages. As with the primary flakes, secondary flakes were manufactured from a variety of material types and varied greatly in size. Although not as reliable as primary flakes as evidence of the use of local material sources, the greater the number and size of secondary flakes in an assemblage and the greater the percentage of dorsal cortex remaining, the greater the likelihood that the materials were acquired locally or from not too great a distance.

3.2.2.1.3 Tertiary Flakes

Synonymous with interior flake, this term refers to any flakes removed from a prepared core or tool. The dorsal face is entirely occupied by previous flake scars, and lacks cortex. Tertiary flakes can represent the residue from tool manufacture or maintenance or further preparation of a core. They were also produced for use as cutting or scraping implements (with or without purposeful retouch or modification), or for use as preforms for other tools (e.g., projectile points, drills). The size of tertiary flakes varied greatly, although generally averaged smaller than primary and secondary flakes. They were made from a variety of material types including a variety of materials not recognized as occurring locally (e.g., obsidian).

In addition to the general categories of secondary and tertiary flakes there were several distinctive subtypes recognized during the Abo survey. These subtypes serve to further differentiate variability in the debitage assemblages and are indicative of differing reduction trajectories and tool use.

3.2.2.1.4 Biface Reduction or Thinning Flakes

These represent the reduction of ovate bifaces into well-made knife-like implements, or projectile points, or the residue from biface maintenance (resharpening). They are characteristically thin, have a small, steeply angled, multifaceted striking platform, expanding lateral edges and often exhibit form "lipping". As used here, they are synonymous with the "retouch or rejuvenation" flakes of Wimberly and Rogers (1977:389).

3.2.2.1.5 Uniface Resharpening Flakes

These are flakes detached from the worn working edges of unifacially retouched scraping, cutting or chopping implements. They are typically characterized by the presence of a crushed, worn, or heavily step-flaked dorsal edge on the striking platform (i.e., the former working edge of the implement from which they were detached). The angle of the platform generally more closely approximates 90° (as opposed to a more acute angle characteristic of biface reduction) and the platform is typically a single facet. These can be flakes removed from flake, core or cobble tools. They are made from a variety of materials and are typically small to medium size (2 to 4 cm.

long) flakes. They are presumably an important indicator of in-place activity.

3.2.2.1.6 Hammerstone Spalls

These are flakes removed from the working edge or "face" of hammerstones. The term spall is applied as it is felt their occurrence is the product of unintentional removal during stone-on-stone percussion rather than purposeful detachment. They are typically characterized by a heavily battered/crushed "platform" or proximal edge and are generally (although no always) primary or secondary flakes. Hammerstone spalls are often quartzite with other materials also represented. They are also typically medium-size (3 to 5 cm.) flakes although some smaller specimens were noted. As with the resharpening flakes these artifacts are presumably good indicators of in-place activity.

3.2.2.1.7 Retouch Flakes

These are the minute or quite small flakes removed from the edges of stone tools in the finishing or resharpening process. These thin flakes generally average 0.5 cm. square to 0.3 by 1.0 cm. or smaller. A number of these flakes presumably represent small biface reduction and uniface resharpening flakes. Their small size and the difficulty of adequately examining the platforms during the field reconnaissance prompted their identification as a separate flake type. Most are made of fine-grained cherts, chalcedonies, quartzites and indurated sandstone. However, other materials are represented. They are an important indicator of in-place activity.

3.2.2.1.8 Trimming Flakes

These represent flakes not obviously the product of biface reduction or tool use and resharpening; they appear to represent the reduction of cores and the manufacture of tools. They can be flakes removed to prepare a core or tool and also flakes struck off to be used as unmodified tools or as "blanks" for future modification. Trimming flake, as used here, is synonomous with the "normal" and "standardized" flake of Frison and Bradley (1980:24-26). To a certain degree this category also represents a catchall for those flakes not readily assigned to another more specific category. Trimming flakes are typically the most common flake type encountered on the Abo project sites. They exhibit the greatest range in size and material diversity of any of the flake types documented.

3.2.2.1.9 Angular Debris

These are angular fragments of stone that exhibit concoidal fracture as evidence of percussion yet lack definable flake or tool traits (synonymous with angular shatter). Angular debris was a common artifact type encountered during the Abo survey and varied widely in size and material diversity. In certain situations, the presence and relative frequency of

angular debris can be an important indicator of the technological precision of a stone knapper or indicative of the level of concern exercised during a particular reduction trajectory. For example, Schutt (1980) working with Anasazi and Archaic site assemblages in northwestern New Mexico showed that there was a statistically significant difference between the flake-to-angular debris ratios which could not be explained by material type or reduction stage alone, and that the differences could be related to technological technique. As used here, angular debris is recognized as being associated with stone knapping activities and does not include fire-cracked rock fragments.

3.2.2.2 Flaked Stone Implements

This classification includes those artifacts which represent tools. Included are items which were manufactured by percussion or pressure flaking cobbles, pebbles, cores, and flakes (blanks, preforms) in order to produce a specific implement or working edge. Also included are the cores from which flakes were produced and unretouched flakes or cores modified through use only. The following sections identify the terminology used to identify the Abo survey flaked stone tools used in the analysis of site types and discusses the variability inherent in the tool types.

3.2.2.2.1 Cores

These artifacts represent the parent mass from which flakes were removed for various uses. The Abo survey inventory of core types is impressive. They can be separated into three major divisions: cores originating from pebbles or cobbles; those originating from tabular, angular or sub-angular chunks or blocks; and cores originating from flakes. Within each of these divisions there is a variety of morphological types and differing degrees of core reduction. There is also overlap between the cobble and angular chunk divisions in reduction trajectories, techniques and degrees of use.

Cobble and pebble cores were manufactured from the rounded quartzite, chert, chalcedony, indurated sandstone, petrified wood, and igneous cobbles and pebbles that occur as terrace gravels along the Pecos River and tributaries and as pediment or lag gravels elsewhere throughout the study area. They were also manufactured from the rounded chert nodules which erode out of the San Andres limestone formation west of the Pecos River.

Cobble cores include the following: cobbles with flakes removed unifacially or bifacially from one edge or end (cobble uniface or cobble biface cores); cobbles with flakes removed from several different directions in a random or non-patterned fashion (multiface or irregular cobble cores); and cobbles with flakes removed bifacially from around the circumference (discoidal cobble cores). Essentially the same series of core types were manufactured from pebbles (with the exception of discoidal cores). The primary differences are the size of the parent mass and resultant flake size [e.g. small to medium (2cm to 4 cm long) flakes from pebbles and medium to large (3cm to greater than 5 cm long) flakes from cobbles]. The reduction of cobble cores tends to

produce considerably greater numbers of secondary and primary flakes than tertiary flakes.

The tabular, angular or sub-angular cores noted during the Abo survey were manufactured primarily from the angular chunks of San Andres chert which occur in the San Andres limestone formation. They were also manufactured from sub-angular chunks of petrified wood and various cherts originating at unknown sources. Included in this core division are unidirectional, bidirectional and multidirectional cores, microcores, bifacial cores and discoidal cores. Microcores are typically small (generally less than 4 cm, square) multiface cores with flake removals that average 2 to 3 cm long. Some of the multiface cores have been substantially reduced resulting in an exhausted core or core nucleus from which further flake removal would have been difficult. However, some of these may have been subsequently used as microcores or were recycled and used as small scraping implements.

The reduction of the tabular or angular cores typically produces more tertiary flakes than secondary or primary flakes. It is noted that the distinction between a cobble multiface core which has had all of its cortex removed and an angular multiface core is negligible, and unless the analyst is familiar with the range of source materials, differentiation would be difficult if not impossible.

There are, in addition, several core types that appear to be somewhat more distinctive.

Primary flake or "tested" cores are typically cobbles (although not restricted to cobbles) which have only a single primary flake removed or occasionally several primary flakes (and occasional secondary flakes) removed from different edges or faces of the core. These were at first thought to be "tested" cores, that is, pieces of stone which had been struck to evaluate the quality and potential for further reduction and discarded without further reduction (e.g., see Bond 1979:35,37). However, given the large number of primary flake tools encountered during the survey it is felt that many (or most) of these are cores and represent a reduction trajectory that had as a goal the production of primary flakes only (e.g., Speth and Parry 1980:157-158).

Prepared pebble and occasionally cobble platform cores represent another specific type. This type is characterized by the removal of a single primary flake to prepare a platform and subsequent removal of flakes perpendicular from the platform. Often only two or three flakes are removed from one edge of the platform leaving much of the pebble intact.

A distinctive type of microcore was noted during the Abo survey. These are thin pebbles or thick flakes which have had small flakes (typically averaging 1 to 3cm long and 1 to 1.5cm wide) removed from either one or both faces. The flakes are removed in such a way that the resultant "core" edges are not readily applicable for tool use. Rather, it appears that the specific intent was to produce small flakes. The discovery of utilized "microflakes" at some of the Abo sites lends credence to this as a distinct reduction trajectory (e.g., Figure 3.11b).

Also, some of the cobble and pebble platform or uniface cores and tabular or angular cores were fashioned to produce blades (length twice the width) rather than flakes.

The microflakes could have been employed as cutting or slicing implements for light tasks such as skinning or butchering small mammals or trimming basketry materials. They may have been simply hand held or possibly hafted either singly or in composite sets (e.g., Crabtree 1972:78; Kidder and Guernsey 1919:127; Morris 1980:130)

3.2.2.2.2 Bifaces

Bifaces are identified as artifacts which are bifacially flaked around their periphery, and typically over all or most of both faces. Occasionally bifaces were noted which were facially retouched on one face and marginally retouched on the opposite face. They are generally ovate, lanceolate or triangular in outline and biconvex to lenticular in cross-section. They range in size and degree of workmanship from large, broad, thick preforms with large, poorly patterned flake scars to thin lenticular, knife-like forms with regularly patterned flake scars. A considerable degree of variation was noted for the biface series in general (Figures 3.1, 3.2, 3.3)*. Included are some relatively small short bifaces which are either substantially reduced or represent projectile point preforms (Figure 3.3). The bifaces presumably functioned as cutting or slicing implements (knives) although some may have seen occasional use as scraping implements.

3.2.2.2.3 Projectile Points

Projectile points were distinguished from the general biface series by size, presence of hafting notches or stems and by comparison with artifacts identified as projectile points from other areas. There are some small, unstemmed, leaf-shaped or lanceolate specimens which could have functioned as projectile points or point preforms or which simply represent small knives. Several projectile points were noted which had been recycled into other tools. Projectile point type identification was based primarily on Leslie (1978), Suhm and Jelks (1962), and Jelinek (1967). Both dart or spear points and arrow points are represented. The various projectile point types documented during the Abo survey are discussed in the a later section of this chapter, following the presentation of the site type data. Illustrations of the diagnostic points are also provided in that section (Figures 3.40 - 4.39).

3.2.2.2.4 Retouched Scraping, Planing and Chopping Implements

This is a mixed association of flake, core, pebble and cobble tools that have been unifacially or bifacially retouched marginally and occasionally facially. Many of the artifacts are generalized utility implements potentially applicable to a variety of differing tasks. Others are more formally shaped tools

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* Editor's note: All artifact illustrations in this report are actual size.

Figure 3.1
Miscellaneous Large Bifaces and Biface "Preforms"
a. Isolated Occurrence #133
b. Isolated Occurrence #95
c. LA 45452 #5
d. Isolated Occurrence #159

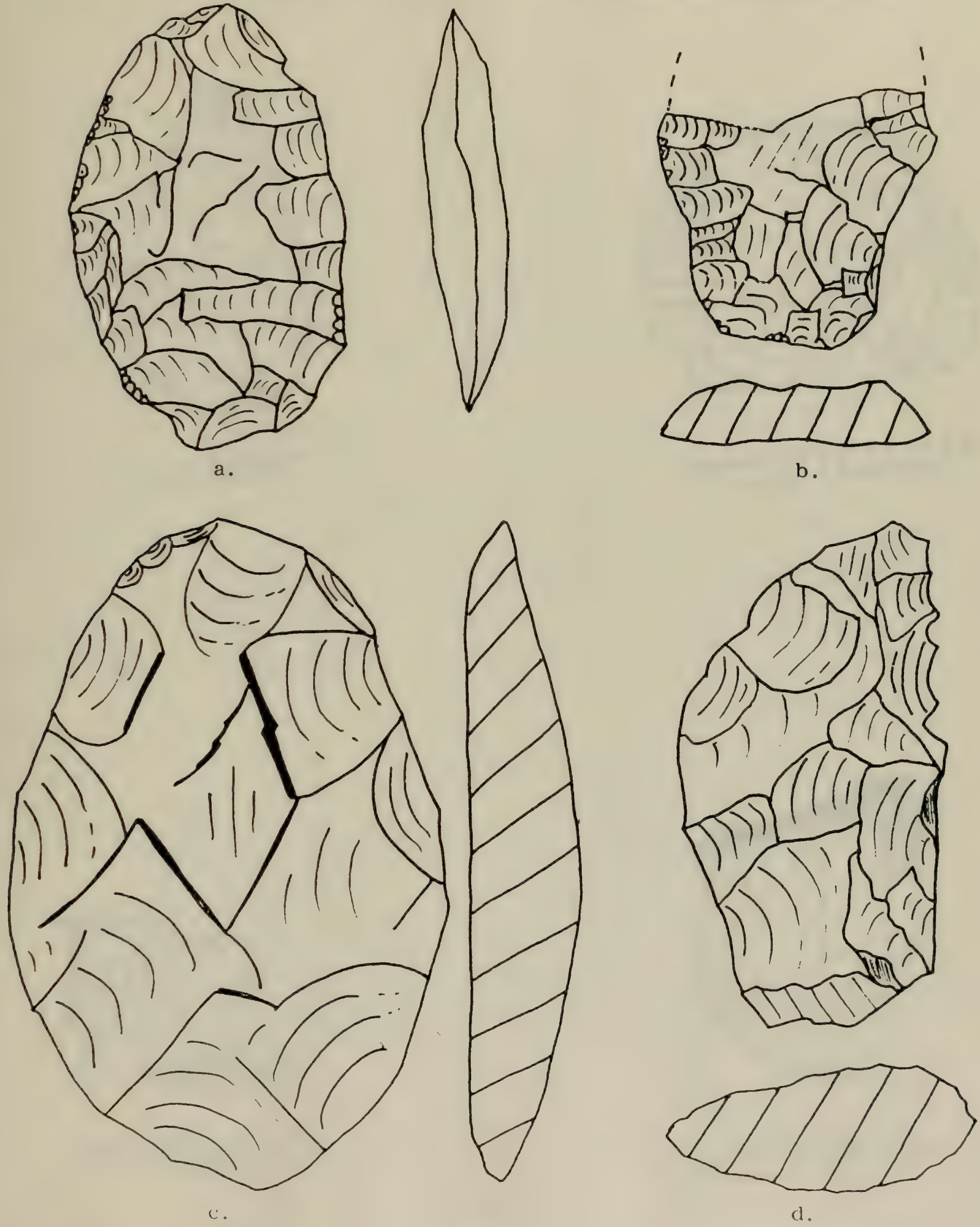
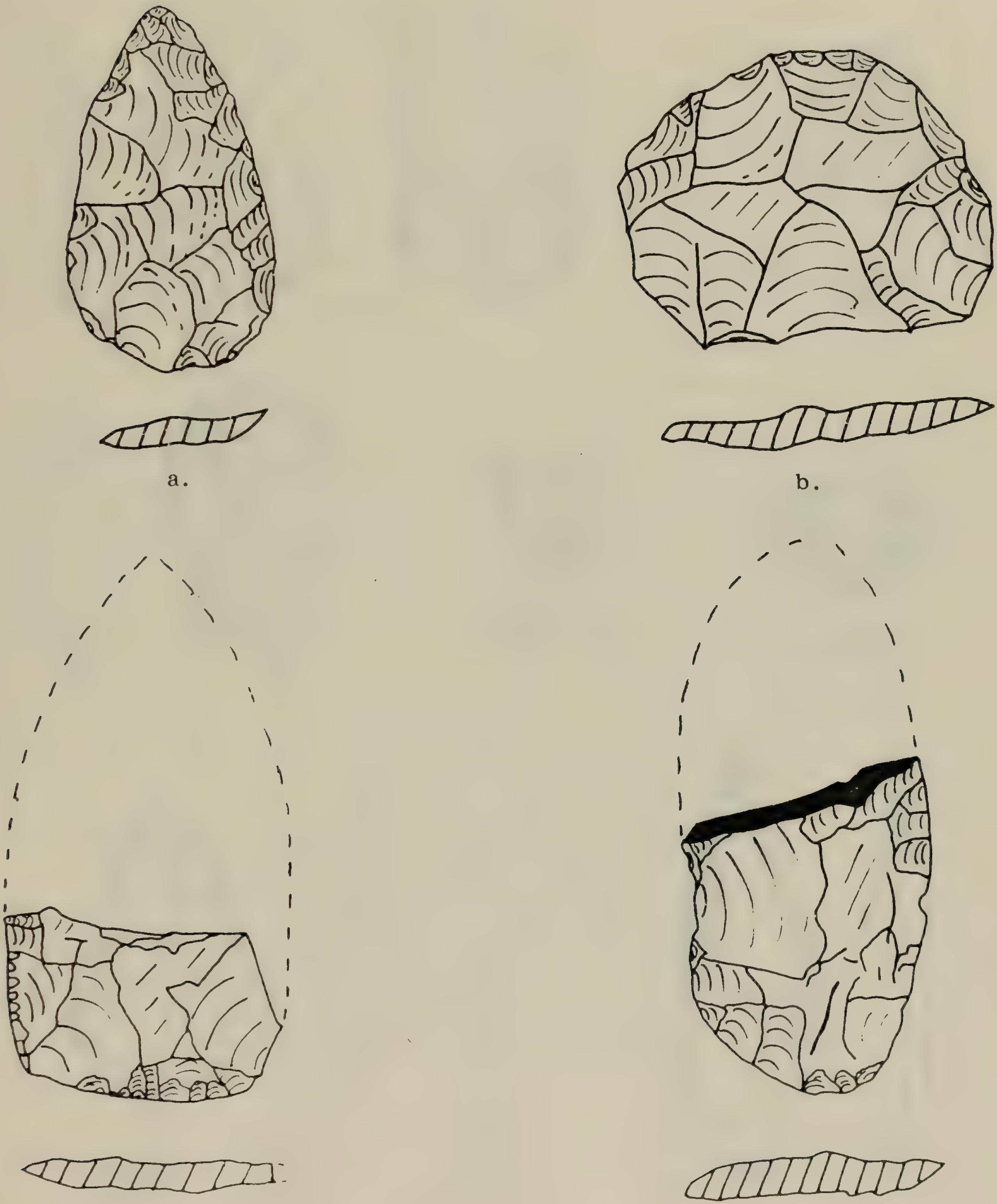


Figure 3.2
Miscellaneous Bifaces

a. LA 44850 #2
b. LA 44863 #1
c. Isolated Occurrence #109
d. Isolated Occurrence #30



a.

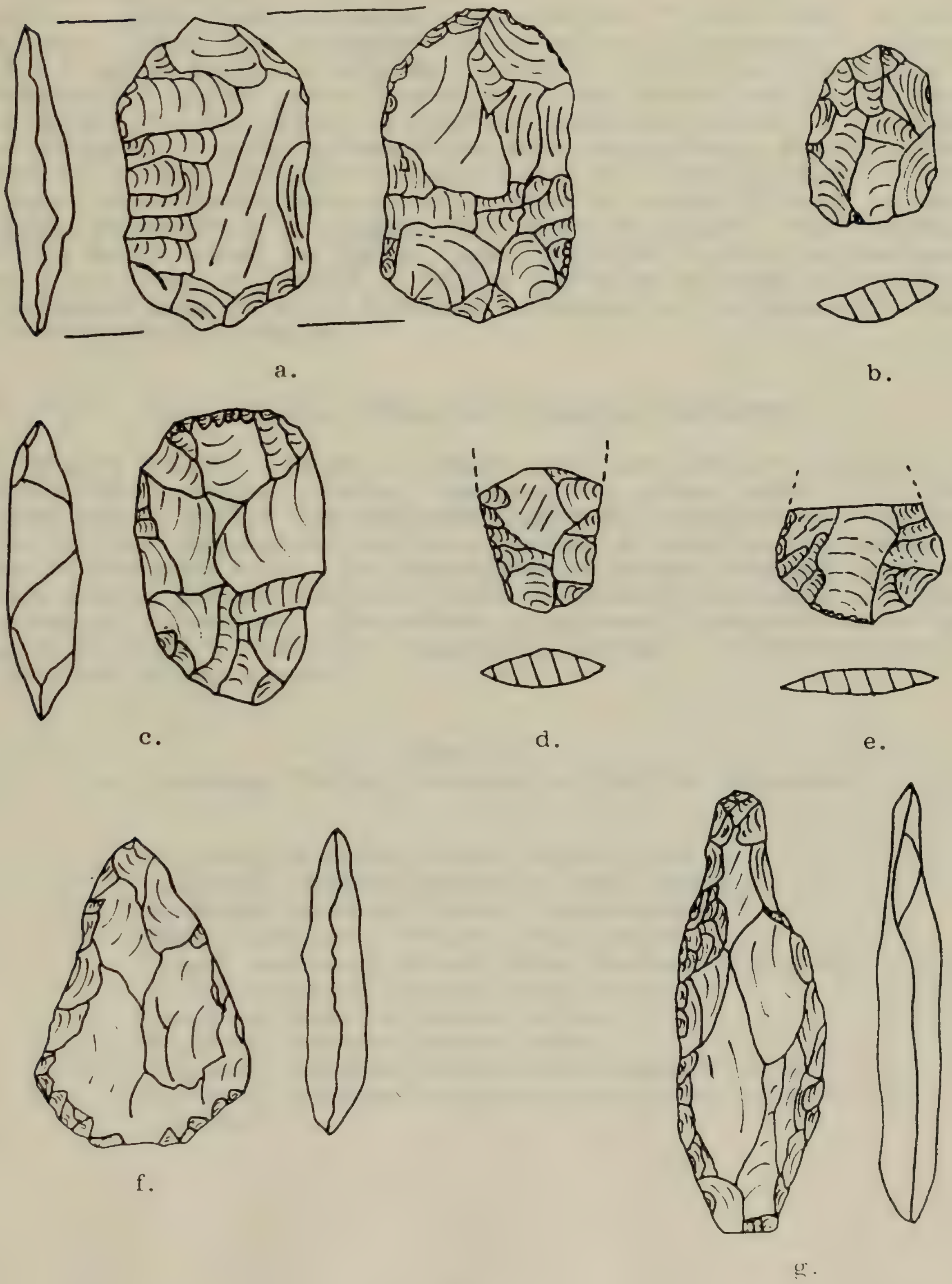
b.

c.

d.

Figure 3.3
Miscellaneous Bifaces and Possible Projectile Point Preforms

a.	LA 45468 #56	b.	LA 44851 #3
c.	LA 44885 #1	d.	LA 44874 #4
e.	Isolated Occurrence #500	f.	LA 44886 #1
g.	LA 44885 #2		



applicable to specific tasks. The position, shape, amount and angle of retouch varies substantially. Depending on the size of the artifact these implements are considered most suitable for cutting, scraping, planing or chopping tasks. Determination of the specific functions represented often requires investigation of a constellation of variables including tool size, tool and edge morphology, edge angle, use wear and resharpening. For the Abo site assemblage analysis this group of artifacts was broken into two categories: "light" flake and pebble implements, and "heavy" cobble and core implements. These two categories are subsequently discussed. Although there is a certain degree of ambiguity inherent in this arbitrary separation, it is considered a realistic initial breakdown of this diverse tool group. That is, it is felt that the degree of functional variability between a retouched flake uniface and a pebble uniface is less than that between a flake or pebble uniface and a cobble uniface or retouched core tool. The assumption is that the larger, more massive tools are better suited to a suite of heavy, cutting, chopping, dismembering or scraping tasks while the smaller, more "delicate" tools are better suited for lighter, more controlled, cutting and scraping tasks. The reader is referred to Hayden (1979) for an excellent review of the variability inherent in the functional parameters of the implements included in this analytical category.

3.2.2.2.5 Light Scraping, Planing and Chopping Implements

This category includes a variety of flaked stone tools which are applicable to relatively light scraping, planing, chopping or cutting tasks. They are typically small to medium size implements (generally averaging less than 7cm by 7cm by 3cm) manufactured on flakes, pebbles or small angular chunks of medium to fine-grain stone. The majority are unifacially retouched along one or more margins although specimens which are bifacially retouched or facially retouched are represented. The variety of implement types included in this category are listed in Table 3.3. Figures 3.4 through 3.11 illustrate some of the variability in this category.

Table 3.3
Light Scraping, Planing, Chopping and Cutting Implements

Marginally retouched Primary flake uniface
Marginally retouched Secondary flake uniface
Marginally retouched Tertiary flake uniface
Facially retouched Tertiary flake uniface
Facially and marginally retouched Tertiary flake biface
Facially retouched Tertiary flake biface
Marginally retouched pebble uniface
Marginally retouched pebble biface
Marginally retouched small angular fragment uniface
Marginally retouched exhausted core nucleus or micro-core uniface

Figure 3.4
Marginally Retouched Primary Flake Uniface Scrapers
a. LA 44874 #36 b. Isolated Occurrence #21
c. LA 44862 #1 d. LA 44862 #2

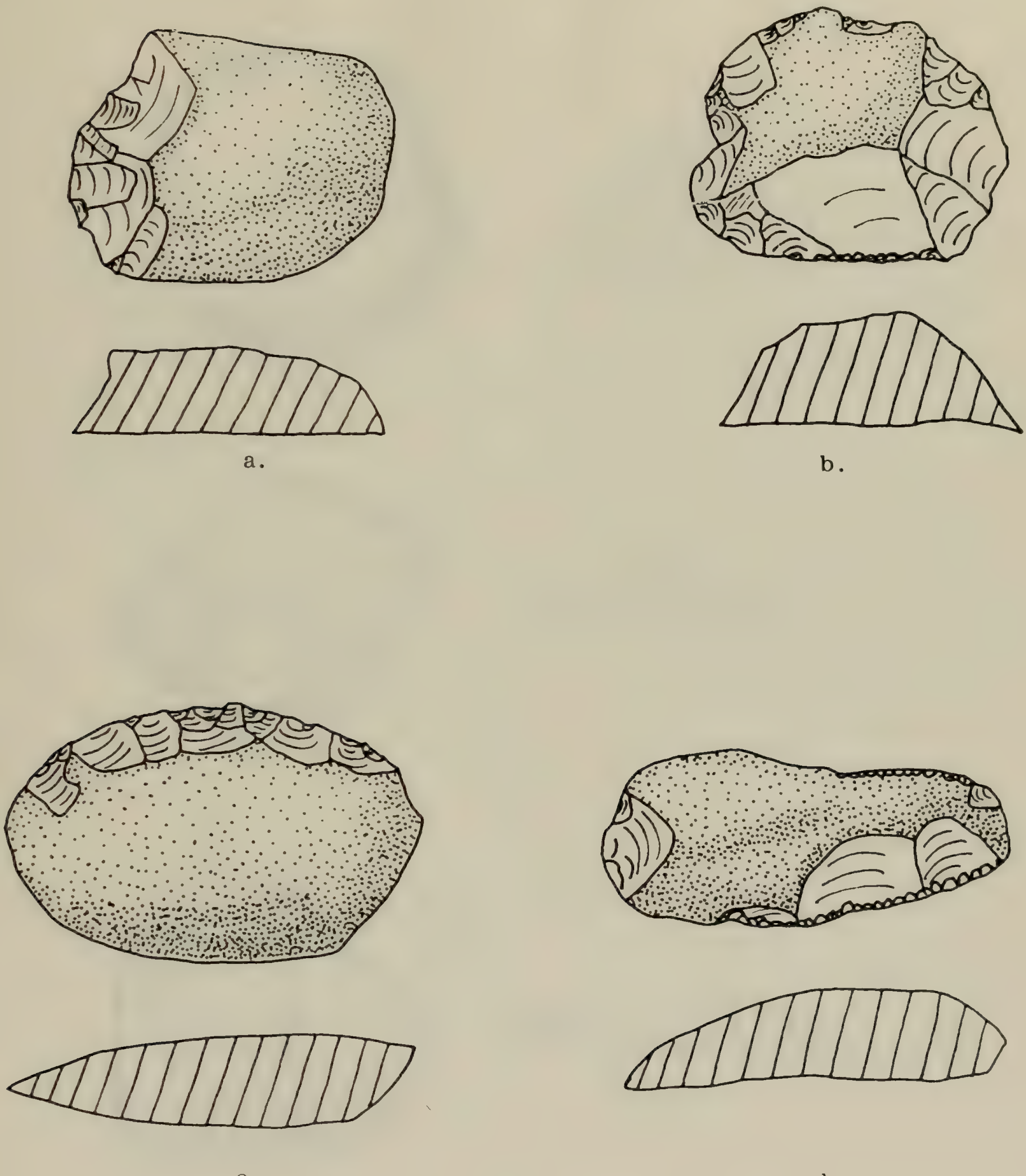


Figure 3.5
Marginally Retouched Primary Flake and Secondary Flake Uniface Scrapers
a. LA 44851 #2 b. LA 44851 #12 c. LA 44850 #A1

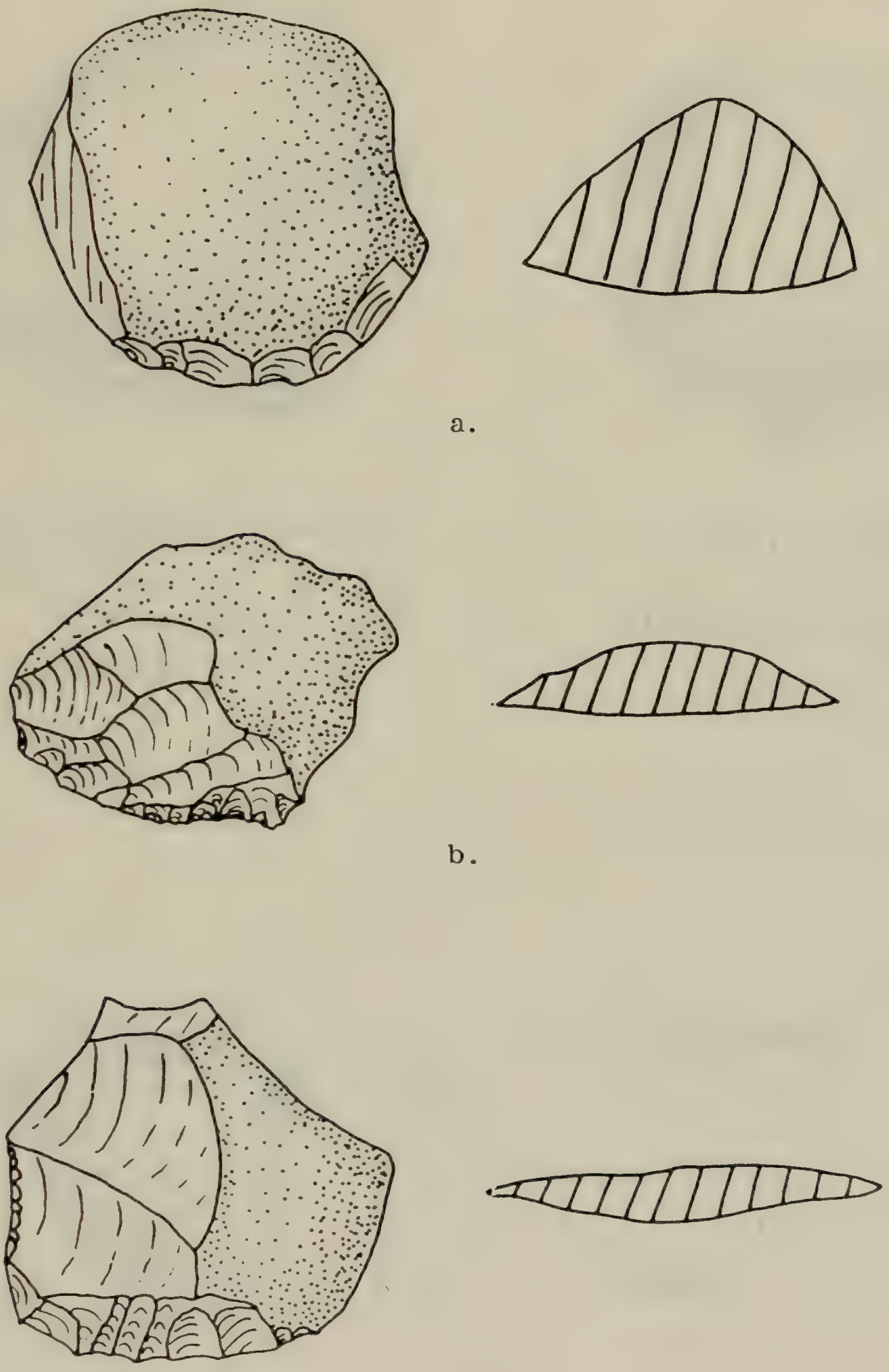


Figure 3.6
Marginally Retouched Primary Flake Uniface Scrapers
a. LA 45483 b. LA 45455 #8 c. LA 44855 #2

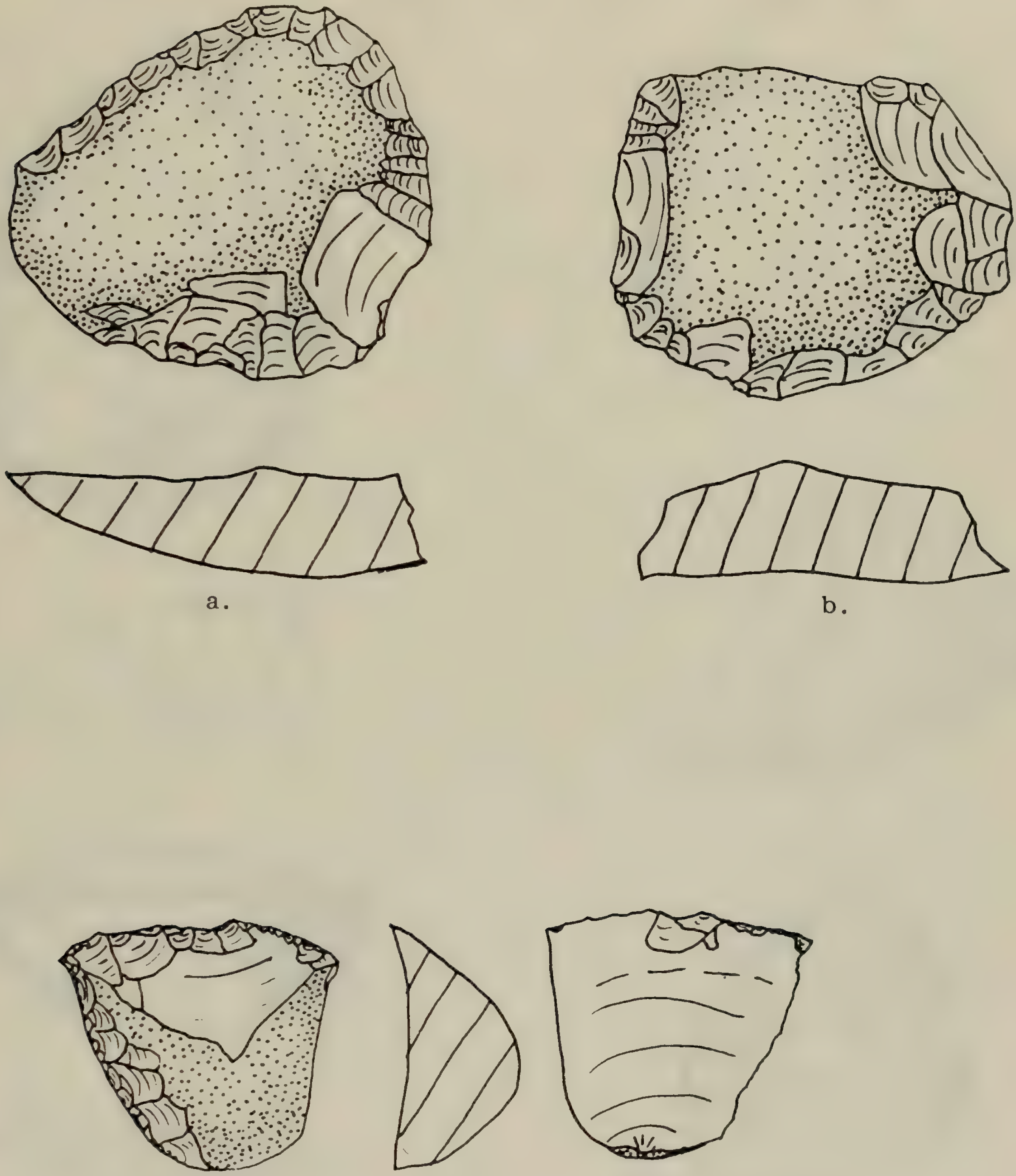


Figure 3.7
Marginally Retouched Secondary Flake Uniface Scrapers (a, c, d)
Cobble Uniface Core/Chopper (b)

a.	Isolated Occurrence #214	b.	LA 44855
c.	LA 44862 #3	d.	Isolated Occurrence #149

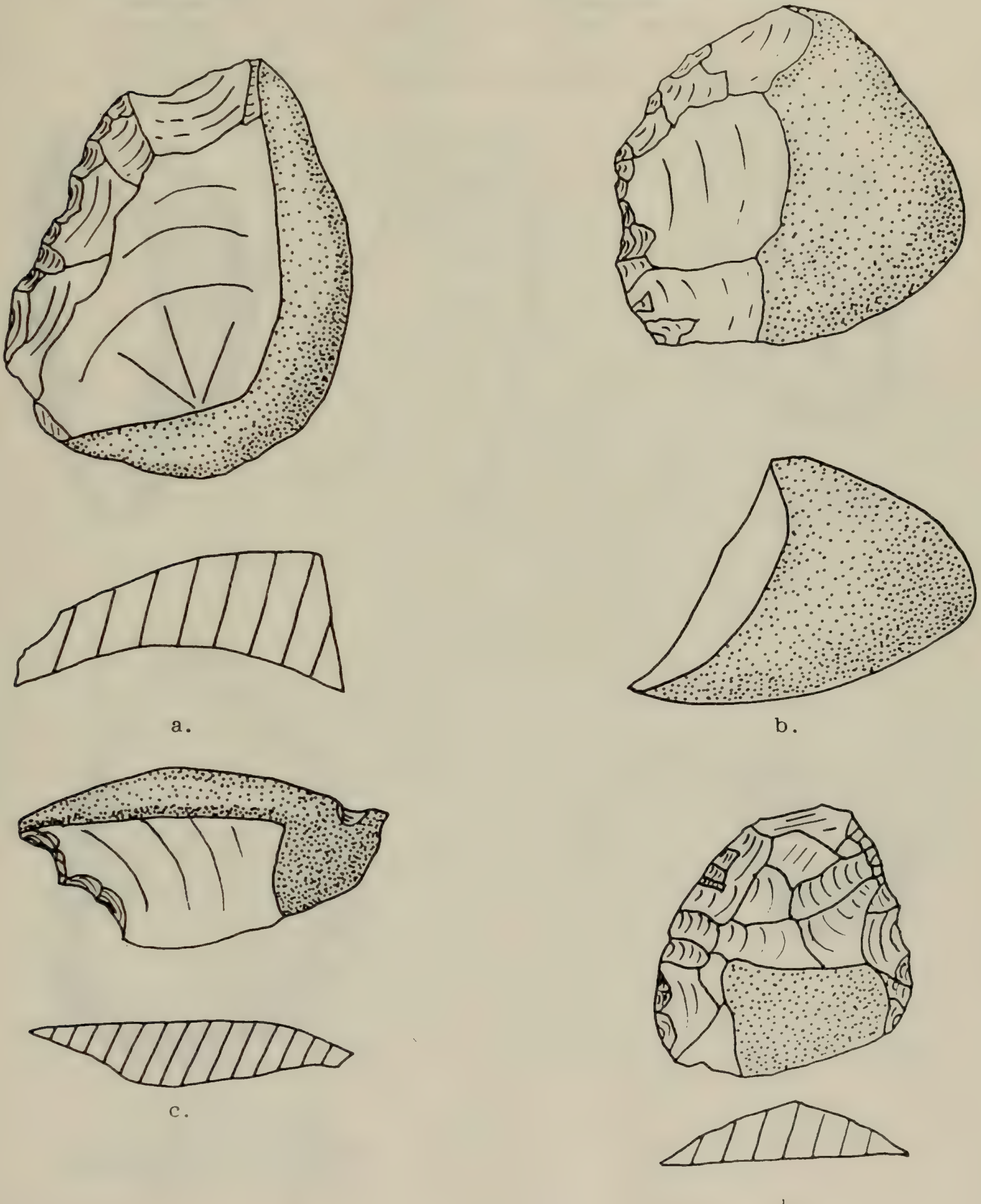


Figure 3.8
Various Scrapers

a. Marginally retouched secondary flake uniface "scraper" or "flake knife", LA 44853 #2
b. Marginally retouched and utilized secondary flake uniface "scraper/flake knife", Isolated Occurrence #47
c. Marginally retouched primary flake uniface scraper, Isolated Occurrence #49
d. Marginally retouched secondary flake uniface scraper, LA 44851 #6

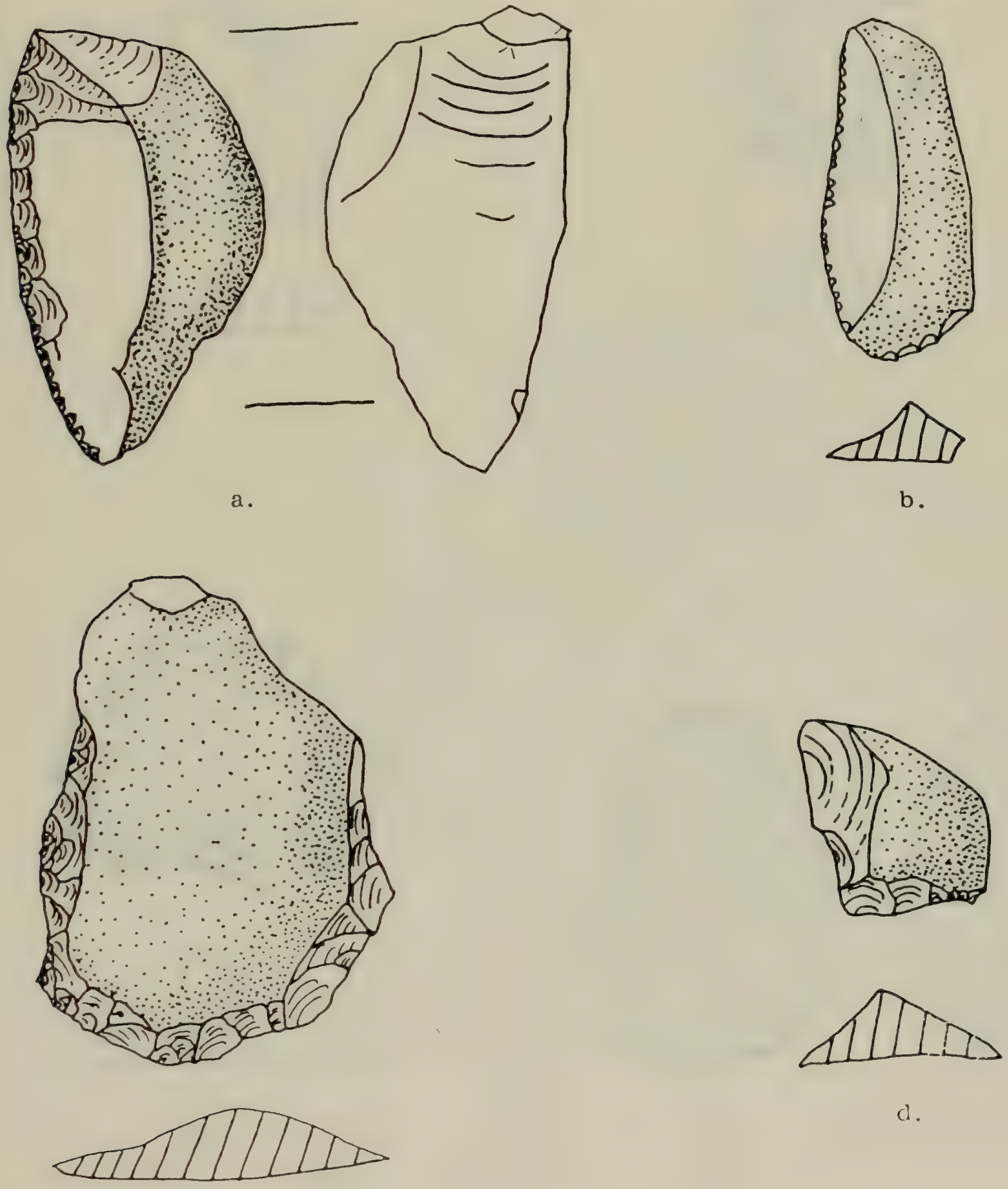
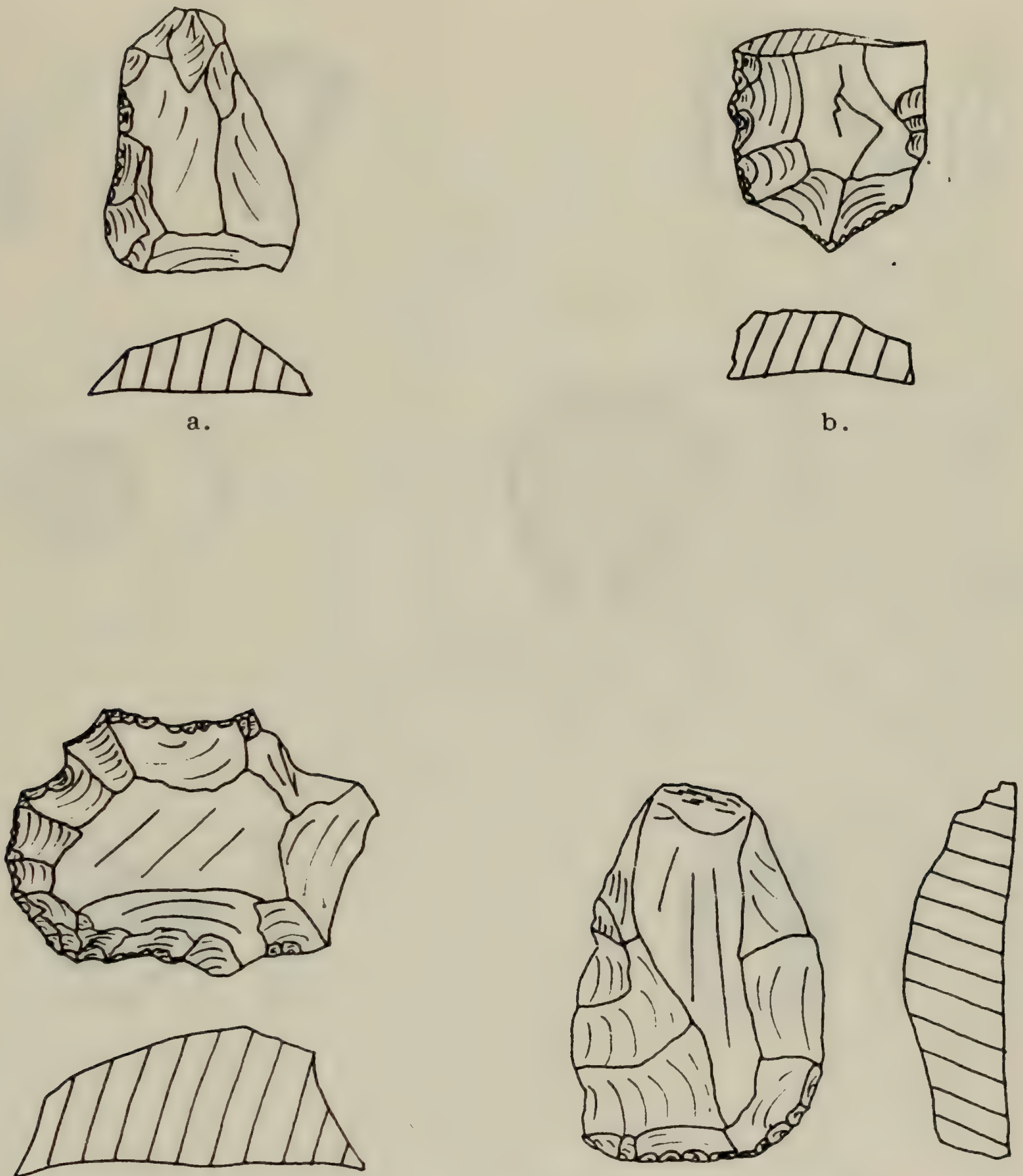


Figure 3.9
Marginally Retouched Tertiary Flake Uniface Scrapers
a. LA 37852 b. LA 44874 #22 (scraper "slug")
c. LA 44874 #27 d. Isolated Occurrence #112



a. b. c. d.

Figure 3.10
Retouched Secondary and Tertiary Flake Uniface Scrapers

a. LA 45468 #37
b. LA 45468 #21
c. LA 44874 #39
d. LA 44874 #23
e. Isolated Occurrence #111
f. LA 44884 #7

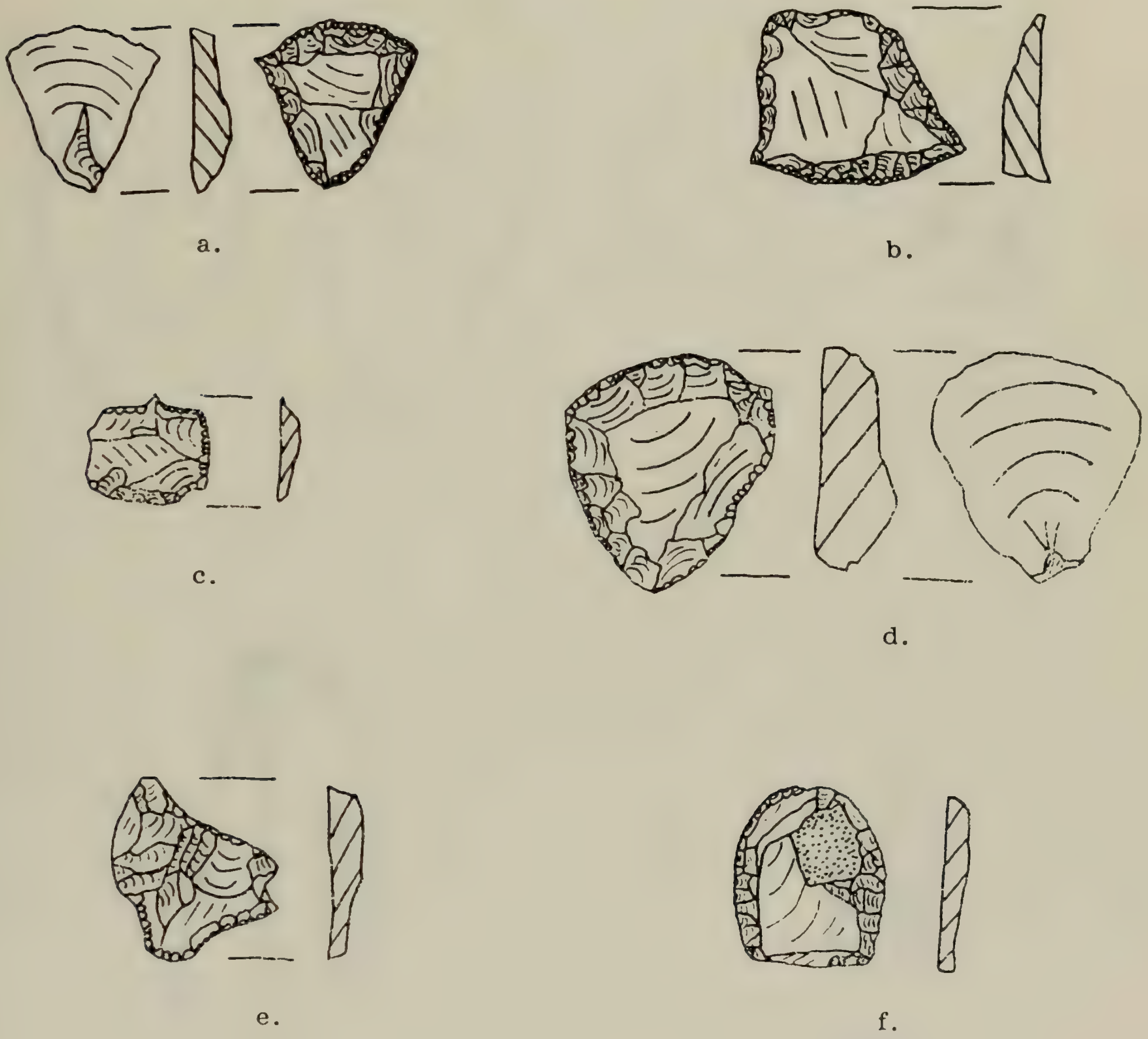
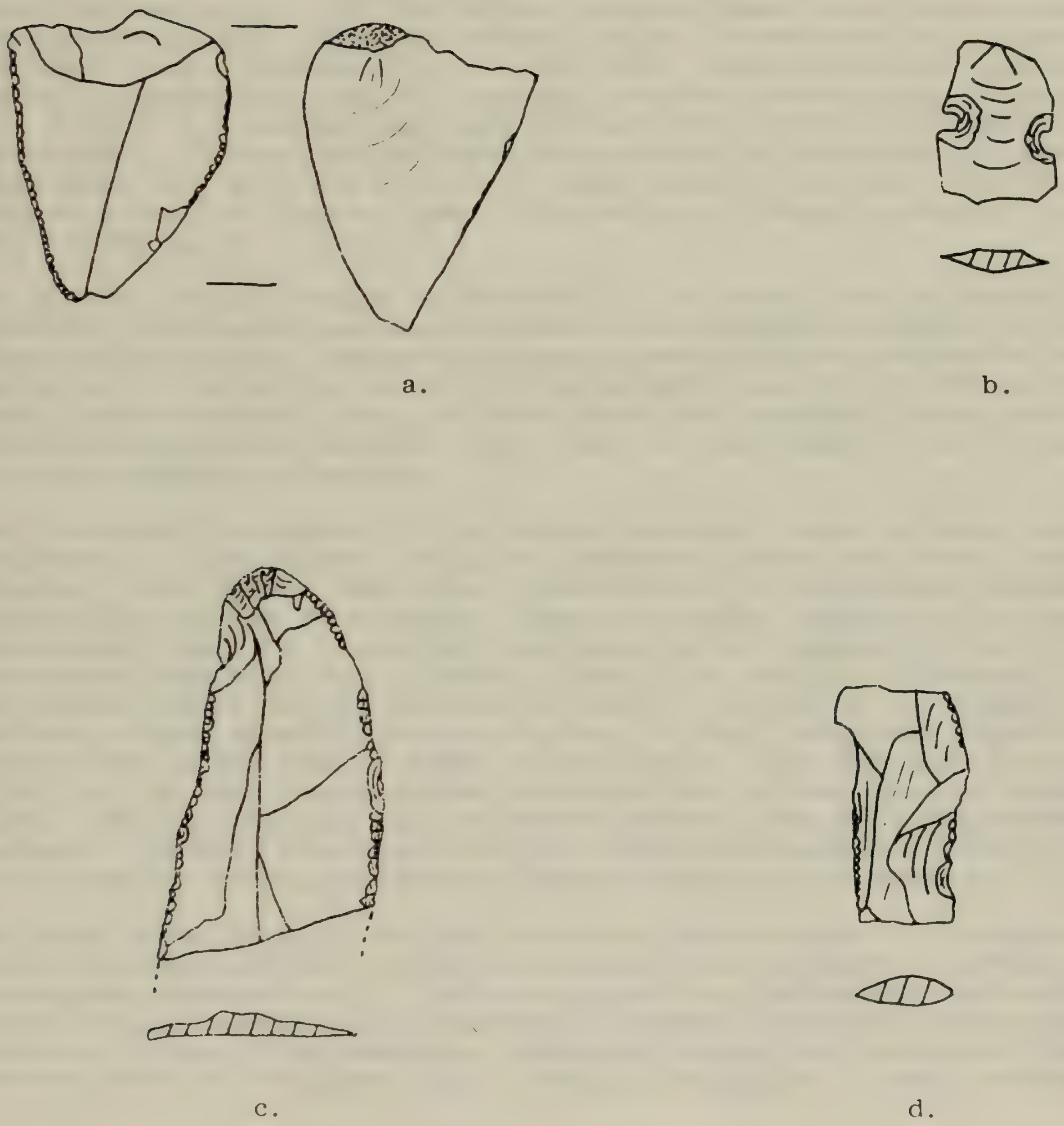


Figure 3.11
Utilized Flakes (a, d);
Retouched (Notched) Tertiary Flake Tool (b);
Marginally Retouched and Utilized Tertiary Flake Uniface
"Scraper/Flake Knife" (c)

a. LA 44853 #1
b. LA 44867 Locus 2
c. Isolated Occurrence #43
d. LA 44851 #5



The angle of edge retouch on these tools varies greatly, ranging from sharp and acute to steep and almost obtuse edge angles. No attempt was made to systematically monitor edge angles during the survey. The differences noted may be related to either functional variability (e.g., slicing, scraping, planing) or to the degree of resharpening (e.g., as a flake scraper edge is resharpened it typically becomes steeper, eventually becoming too steep for further effective use).

Similarly, the amount, form and position of retouch varies greatly from one specimen to another. The amount of retouch ranges from short portions of a single edge (ca. 1 to 2cm long) to around the entire periphery of the tool. This is presumably related to the intensity of use a particular tool received and to the task to which it was applied (e.g., scraping a narrow dart shaft versus hide scraping). The form of the retouched edges varies substantially, although most exhibit moderately straight, slightly convex or slightly concave use edges (e.g., Figures 3.4, 3.5, and 3.6). Some edges are markedly concave, denticulate or exhibit obviously prepared notches (e.g., Figures 3.7c, 3.9c). It is probable that some of these latter specimens functioned as spokeshaves. (It may be significant that a number of the measured notches range from .9cm to 1.5cm in width). Also, some of the flake tools have purposeful spurs or "graver beaks" retouched into an edge or corner (e.g., Figure 3.10a-c).

The location of the retouch or modification also varies from implement to implement. The majority of the flake tools were unifacially retouched on the dorsal surface although occasionally specimens were noted with retouch on the ventral face. The position of the retouch included: along one or both lateral edges ("side scrapers"), along the distal edge ("end scraper"), along one or both lateral edges and the distal edge ("side and end scraper") and around the entire periphery (discoidal).

Two overlapping categories of unifacially retouched flake artifacts were recognized. These include irregular retouched flakes and formal flake scrapers. The former are flakes characterized by purposeful unifacial retouch along one or more edges. These are highly variable in plan and cross-section and are considered representative of expediency tools or non-curated implements (e.g., Figures 3.5b,c; 3.7c; 3.8b,d). Occasionally a "non-formal" flake tool is fashioned in such a manner as to suggest a relatively unique specific task or function. A small marginally retouched tertiary flake uniface from LA 44867 is one example. This thin flake (Figure 3.11b) has two small, deep notches retouched into its two opposing lateral edges. The size and depth of the notches indicate they were purposefully produced. Although conjectural, this tool would have been well suited as a sizing gauge for shaving and shaping basketry splints or rod materials.

The formal flake scrapers are flake implements characterized by the regular removal of flakes unifacially around much or all of the periphery, resulting in a well-made patterned tool. They are typically regular in plan and cross section and are considered more indicative of curated tools than the irregular specimens. Some of the marginally retouched primary and secondary flake unifaces could be considered formal scraping implements (domed discoidal

scrapers, elongated side scrapers, rectangular side and end scrapers, etc.). They appear to represent formal, consistently shaped forms (e.g., Figures 3.4a-c; 3.6; 3.7d). There are several marginally and facially retouched secondary and tertiary flake unifaces that constitute a distinct class of formal scraping tools (e.g., Figure 3.10a,b,d). These are typically ovoid to triangular in plan with low plano-convex cross sections. They are generally retouched along both lateral and the distal edges and often exhibit small spurs at one corner of their distal edge.

Another reoccurring form of small formal flake scrapers are artifacts commonly termed "thumbnail scrapers". These are typically small (averaging 3cm by 3cm by .6cm) tertiary flakes that have been facially or marginally retouched around most or all of the periphery (Figure 3.10c,e,f).

Also noted in the Abo site assemblages are artifacts which represent exhausted scraper "slugs" (Gould et al. 1981; O'Connell 1977). These are typically secondary or (most often) tertiary flake uniface scrapers that have been repeatedly resharpened resulting in a short steep-edged tool with a length shorter than the width (Figure 3.9b). These most likely represent exhausted hafted woodworking or hide scraping tools.

The pebble tools are typically unifacially retouched along one edge or end, and occasionally around most or all of the periphery. As with the flake tools the amount and form of retouch varies substantially. The functional variability is also presumably similar. The differences between the pebble and flake tools is presumably closely associated with lithic material availability and form.

Ultimately the functional variability inherent in this general tool category covers a wide range of potential tasks including woodworking, butchering, hide processing, and working cordage or basketry materials, among others. It is probable that some of the more formal implements in this category will prove to be relative indicators of cultural or temporal variability. Jelinek indicated that the late McKenzie and Roswell phases are characterized by small thick end scrapers and that prior to these late sedentary phases the characteristic small scrapers are relatively thin spatulate forms (1967:111, 112, 114). In this regard, it may be significant that four of the eight scraping implements recovered from the Garnsey site (a late prehistoric - protohistoric bison kill south of the study area) are small thick end scrapers (Speth and Parry 1980:159).

Jelinek (1967:143) also notes that the scrapers illustrated by Fenenga and Cummings (1956:218, Figure 148n-q) from LA 2709 (a relatively large campsite within the study area) resemble scrapers associated with Archaic collections from the Middle Pecos Valley survey. These are reminiscent of some of the tertiary flake end and side-and-end scrapers noted during the Abo survey.

One distinctive scraper form noted on the Abo survey may also be indicative of the Archaic period. These are the marginally retouched tertiary flake uniface side and end scrapers illustrated in Figure 3.10a,b,d. They are well made implements triangular to subrectangular in outline with low

plano-convex cross-sections. They have small graver-like spurs retouched into one side of their distal edges and were probably hafted, curated tools. At the two sites where the illustrated specimens occur they were associated with projectile points reminiscent of the Oshara Tradition San Jose projectile points of mid-Archaic (3200 - 1800 BC) age (Irwin-Williams 1973:Figure 4; see also Leslie 1978:148; Sayles 1983:120-121). Similar scraping implements have also been recovered from Paleoindian sites (e.g., Judge 1973:94-95; Frison 1978:78, 124-126; Wormington 1957). They may represent a potential diagnostic for the Paleoindian through mid-Archaic periods. However, they may represent a particular functionally specific implement design that is more task specific than temporally diagnostic and crosscuts the occupational history of the region. Additional data from a variety of sites will be necessary to test their utility as temporal diagnostics.

3.2.2.2.6 Heavy Scraping, Planing and Chopping Implements

This category includes a series of flaked stone tools which are applicable to relatively heavy chopping, scraping or planing tasks. They are typically medium to large size implements (generally averaging greater than 8cm by 7cm by 3cm) fashioned from cobbles, cores and large angular chunks of stone. A wide range of material types are represented ranging from fine-grained to coarse-grained. Most are manufactured from the quartzite, indurated sandstone and basalt cobbles that occur in the Pecos River terrace and tributary terrace gravels and as lag and pediment gravels elsewhere in the study area.

The variability evident in this category is considerably less than that represented in the light scraping, planing and chopping implement category. The majority are cobbles which have been unifacially or bifacially retouched along one edge or end (cobble unifaces, cobble bifaces; Figures 3.7b and 3.12). However, unifacially or bifacially retouched split cobbles (split cobble unifaces, split cobble bifaces) are well represented and unifacially or bifacially retouched tabular chunks or angular chunks (occasionally recycled cores) also occur. Split cobbles are cobbles that have been broken in half along their longitudinal axis. The resultant cross-section is typically low plano-convex (Crabtree 1972:41). This is in contrast to "halved" cobbles which are broken across the short axis resulting in a high plano-convex cross-section. Occasional tools manufactured from halved cobbles were also noted.

The retouched edges are often sinuous or coarse-denticulate and range from relatively straight to slightly convex to sharp convex. Flake removal varies from one-fourth to the entire periphery, although instances of the latter are rare. The edge angle varies from sharp and acute to steep, almost obtuse, and presumably reflects the amount of resharpening or function (i.e., scraping, planing or chopping-dismembering).

These tools are considered applicable to a variety of tasks including coarse woodworking (chopping, scraping, planing), butchering large mammals (dismembering, chopping), processing plant fibers (planing, pulping) and digging (rooting-grubbing), among others. Edge angle, and edge wear are

considered critical variables for differentiating functional variability. For example, a cobble uniface employed in a heavy chopping task will typically have an acute to moderate (e.g., 45 to 75 degree) edge angle and exhibit use wear in the form of a "worn" (smoothed, lightly rounded) edge with irregular bifacial step flake edge damage. A cobble uniface employed in a scraping or planing task can typically have an edge that is either relatively acute (about a 40 to 50 degree angle) or relatively steep (about a 80 to 90 degree angle) and exhibit use wear in the form of a "worn" (polished-rounded) edge, unifacial step flake edge damage and polish or fine striations perpendicular to the edge on the basal face. Observation also indicates however, that there can be considerable variability in the edge angle and use wear evident on a single artifact and many were presumably used for multiple tasks. Also, the amount of use and resharpening a tool received has a direct affect on the observability of use wear. One problem encountered during the Abo survey was differentiating between cobble uniface or biface tools and cobble uniface or biface cores. The presence of use wear and the nature of the flake removals were criteria considered when differentiating these items. Any specimens lacking obvious use wear were generally identified as cores. The amount and placement of the retouch was also used as an indicator of tools versus cores. For example, the cobble biface illustrated in Figure 3.12 lacks readily observable edge damage or use wear. However, it is considered a chopping implement rather than a core because of the size of the flakes removed, the regularity of their removal, and the resultant edge morphology.

This class of implements are common general utility tools that presumably span the occupational history of the region. They are not considered a typical part of a curated tool kit carried about by mobile hunter-gatherers. However, they were presumably employed as expediency tools when need and availability converged. Also, they may have served as "site furniture" (Binford 1977, 1978) at periodically used temporary camps or more sedentary habitation locales where they would have been available for any number of situational tasks.

A number of these tools exhibit battering scars in the form of crushing and intense step-flaking on their corners, points or edges. This wear pattern is considered indicative of stone-on-stone percussion and these implements are identified as hammerstones and discussed in the battered stone artifact section.

3.2.2.2.7 Drills, Borers and Perforators

These are flaked stone implements shaped for use in boring, drilling or perforating tasks. They are characterized by a bifacially retouched elongate projection. Both formal shaped drills and informal modified flake drills are represented. The former are generally well made and are retouched over both faces with a narrow elongate point, diamond-shaped to lenticular in cross section. Some appear to be recycled biface fragments or extensively retouched bifaces. The informal drills are flakes with a point or projection accentuated by marginal bifacial retouch and applicable to boring, drilling or perforating tasks.

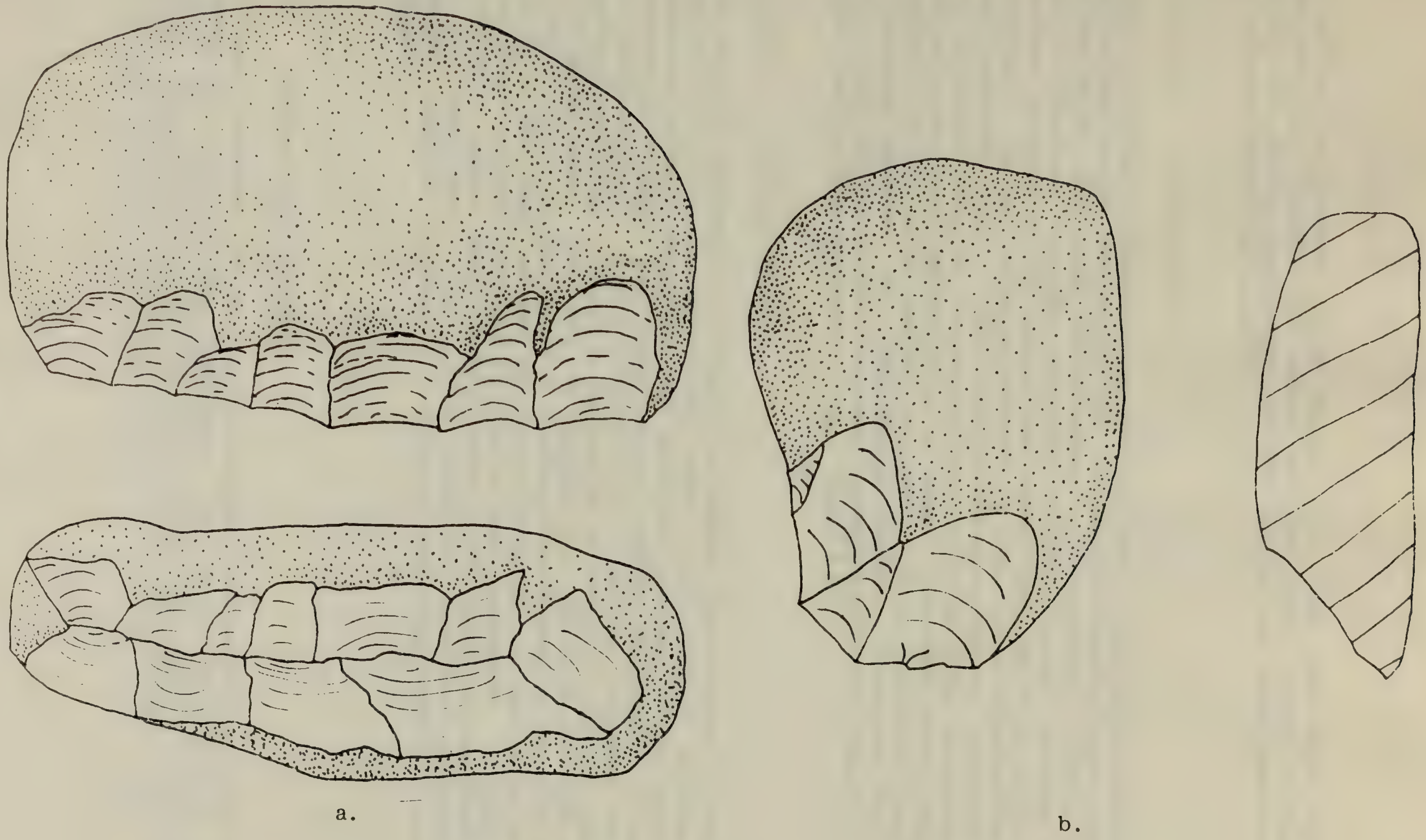


Figure 3.12

a. Cobble Biface "core chopper"

b. Cobble Uniface "scraper/chopper"

In addition two projectile points (Figure 3.43l, 3.46f) were noted where the tips had been retouched into narrow drill-like points. Drills are relatively rare in the Abo site assemblages and some of the more formal specimens may be potentially temporally sensitive.

3.2.2.2.8 Utilized Flakes

These are primary, secondary, or tertiary flakes which exhibit evidence of modification through use rather than intentional retouch (Figure 3.11a,c). Utilized flakes were made from a variety of fine-grained materials (e.g., chert, chalcedony, quartzite, indurated sandstone, basalt, petrified wood) and are characterized by minute flake scars along the edge of the flake ("nibbling"), a worn, ground or polished use edge, or an irregularly notched edge (crescentic scars). They are considered expediency implements that were presumably used for a variety of tasks including slicing plant materials, meat or leather, and scraping wood or skins. They are almost ubiquitous throughout the Abo study area and collectively are not considered temporally or culturally sensitive. The differentiation between a "retouched flake tool" and a utilized flaked (in many instances) presumably reflects intensity of use rather than functional differences (e.g., Figure 3.11).

3.2.2.2.9 Utilized Cores

This class of implements is similar to utilized flakes except it includes artifacts that are characteristically cores which exhibit evidence of modification through use rather than intentional retouch. Utilized cores are characterized by edges that exhibit minute unifacial flake scars, or have a worn smoothed edge. They were made from a variety of materials and are considered expediency implements employed in a variety of scraping, planing or chopping tasks. One form of utilized core was observed with some regularity. They are microcores or small core nuclei made of chert or other siliceous material which exhibit use retouch along one or more steep edges. They appear to have functioned as small scraping implements. Although not as common as utilized flakes, utilized cores do occur at a number of sites in the Abo study area. They are not generally considered culturally or temporally sensitive. However, the type of core utilized may be somewhat diagnostic.

3.2.3 Battered Stone Artifacts

This class of artifacts includes those implements which exhibit battering scars resulting from stone-on-stone percussion. All of the implements in this category are considered hammerstones. They are separated into two analytical groups based on the morphology of the working edge or face and hypothesized functional variability.

3.2.3.1 Unmodified Cobble Hammerstones

These are whole cobbles that exhibit no modification other than that caused by stone-on-stone percussion or battering. This is typically a pitted or crushed area, often with spalled flake scars associated, located at one end or along the side of the cobble. They are made from a variety of materials, most notably the quartzites, indurated sandstones and basalts that are common in the terrace, pediment and lag gravels that occur in the study area. These artifacts presumably functioned as percussion tools for stone knapping tasks (i.e., core reduction, tool manufacture and maintenance). They are not considered temporally or culturally diagnostic.

3.2.3.2 Angular Hammerstones

This class of implements encompasses a diverse set of artifact types. Included are cores, retouched cobbles, large flakes, large angular fragments and cobble fragments. The distinguishing feature linking all these artifacts is the presence of crushed or heavily step-flaked edges or corners. The following angular hammerstone types were identified during the Abo survey:

edge battered large primary flake
edge battered large secondary flake
battered cobble uniface
battered cobble biface-uniface
battered cobble fragment
battered core
battered core fragment
heavily battered globular or spherical hammerstone nucleus

The battering wear occurs most notably at the intersection of two or more flake scars or at corners, points or projections on the tool. The amount of battering varies considerably from slight to extreme (in some instances resulting in a heavily battered rounded spherical form). They are manufactured from a wide variety of materials (quartzite, indurated sandstone, basalt, chert, chalcedony, etc.) and many appear to represent recycled tools originally fashioned for another purpose (e.g., cores, cobble uniface choppers). These tools are considered to have functioned primarily as pecking tools for resharpening milling equipment. However, they may have been employed in other coarse battering or mashing tasks (e.g., crushing or breaking large mammal bone). Although not presently considered temporally or culturally diagnostic, they are important functional indicators.

3.2.4 Groundstone Artifacts

The artifacts in this category are characterized by ground and pecked surfaces generally resulting from stone-on-stone abrasion. All of the groundstone artifacts noted during the Abo survey are related primarily to food processing activities and are indicative of two functional complexes: the

milling complex and the pounding-pulping complex (King 1967:33; King, Blackburn and Chandonet 1968:44).

The milling complex is composed of handstones or manos and milling stones or metates. These artifacts have been lumped for analysis under the heading of milling equipment. The handstone and milling stone and the mano and metate function together for grinding or milling food resources, most notably hard seeds and corn. The handstones and manos are the active elements of the set while milling stones and metates are the passive elements. The terms mano and handstone and metate and milling stone are generally synonymous. They are distinguished by the manufacturing mode. Handstones and milling stones are modified by use with little or no prior preparation. Manos and metates are more formal implements shaped prior to use into standardized forms. Also, manos are typically broad enough to be used with two hands, while handstones are typically smaller and suited for one-handed use. Only a small number of the handstones noted could be considered manos. These are shaped rectangular two-hand forms with bifacial use wear. Most handstones are made from unmodified sandstone or quartzite cobbles with either unifacial or bifacial use. Some of the handstones exhibit shaping around their periphery. The milling stones are typically made from unshaped sandstone slabs and most are represented by fragments. Some exhibit rough shaping of the periphery by percussion flaking. Several sandstone block or basin milling stones were also discovered. No trough metates or other formal metates were noted. The paucity of formal shaped milling equipment (manos, metates) is consistent with the results of the Haystack Mountain Off Road Vehicle survey (Bond 1979) and with Jelinek's Middle Pecos Valley survey (1967:112, 113, Plate VIII). Jelinek notes that the "manos" were characteristically relatively small and thick with rounded ends, and that the "metates" were either casually trimmed sandstone slabs or basin-shaped (1967:112, 113, Plate VIII). Jelinek (1967:122) does note the occurrence of loaf-shaped manos at a large ceramic period site. Many of the Abo survey handstones and milling stones exhibit pecking or resharpening scars.

The pounding-pulping complex is composed of tools typically utilized for processing vegetal or animal resources by pulverizing or pounding. Two artifact classes are included in this division: mortars and pestles. The pestle is the active element and is used in an up-and-down pounding process or rotary crushing motion. The mortar functions as the base stone or passive receptacle. These artifacts are generally considered indicative of acorn or mesquite pod processing. However, they may have been used for processing a variety of materials including faunal resources. No pestles were noted during the Abo survey and only a single mortar fragment was discovered. The fragment is a rim portion from a portable, shaped sandstone boulder mortar. Similar mortars have been noted in the Middle Pecos Valley (Jelinek 1967:113) as have bedrock mortars (Jelinek 1967:113; Bond 1979). The presence of mortars may be indicative of the ceramic period in this area. The Abo survey specimen was found at a site containing ceramics and Jelinek (1967:113) notes that bedrock mortars occur most often where bedrock outcrops occur adjacent to sedentary sites. However, only 50% of the Haystack Mountain survey bedrock mortar sites included ceramics in their assemblages (Bond 1979). The single mortar fragment has been included in milling equipment category for analysis.

3.2.5 Modified Shell Artifacts

This is a small class of artifacts represented by two types of modified shell. One includes a small fragment of freshwater mussel shell (Anodonta grandis?) which has had a small notch worked into one straight edge. The fragmentary nature of the specimen negates further identification. However, Jelinek (1967:113) notes the presence of freshwater shell pendants and beads at some of the ceramic horizon sites recorded during the Middle Pecos Valley survey. Also, a "tremendous amount of freshwater shell beads, pendants, worked and semi-worked pieces" was recovered from a pueblo ruin and pithouse complex (ca. AD 1300 - 1450) along the Rio Hondo near its confluence with the Pecos River (Ross 1975:4).

The other modified shell artifact is a single shell bead. This is a spire-lopped Olivella sp. shell bead noted at LA 45464, a large ceramic period campsite. The bead perforation was formed by grinding off the spire end. Determination of species was not possible due to the removal of the spire. A Pacific coast or Gulf of California origin is possible. Jelinek (1967:113) notes the occurrence of a carved stone olivella bead replica at a Late Mesita Negra site in the Middle Pecos Valley.

Due to the limited number of specimens this artifact class was not included in the analysis.

3.2.6 Artifacts Eliminated from the Analysis

A small number of stone artifacts were also eliminated from the assemblage analysis. These include items identified as miscellaneous flaked stone tools. They are relatively few in number and are typically retouched angular fragments, or fragments of unidentified chipped stone tools. Also eliminated were a single heavily edge worn (ground-rounded) cobble biface and a single Pecos "diamond" (quartz crystal) with a ground tip. These items were eliminated from the analysis because of their limited numbers and functional ambiguity.

3.2.7 Features

Features are defined as non-portable products of past human activity. Features recorded include aboriginal hearths, rock rings, a possible rock alignment and historic structural remains. The number of features within these classes is low except for hearths. The historic remains are discussed in the historic site section (Chapter 3.3.1)

The hearth features observed range from roughly 50 centimeters to over nine meters in diameter, and exhibit considerable variability in content. The majority are evidenced by clusters of fire-reddened or burned sandstone, limestone, caliche or quartzite cobble fragments. In some instances, these are associated with blackened sand or charcoal and some have burned bone associated. Several hearths lack any surface stone association and are evidenced by burned black soil and ash stains, often with charcoal intermixed.

Preservation or integrity of the hearths is also highly variable. Some appear to be relatively intact while others are severely eroded and scattered. No attempt has been made to type the hearth features or to determine the distribution of the different types. Differential access to suitable stone presumably affected hearth content. However, it is probable that the variability among the hearth features is indicative of a variety of functions. The size of the hearth features varies considerably and presumably reflects differences in function (e.g., domestic hearths versus roasting pits). Also, the scattered fire-cracked and burned rock noted at many sites may represent the residue from cleaning out a roasting pit (as opposed to a severly eroded one) and potentially indicative of undetected cooking features.

Rock ring features were noted at two locations within the sample units. One site, LA 45452, is located in a sinkhole enclosure and contains a sparse lithic scatter and six rock ring features. The features are roughly circular, open single course limestone block rings ranging in diameter from 3.5 meters to 6 meters. They are often interpreted as "tipi rings", with the rocks functioning as weights to hold down the outer edge of the tipi. Jelinek (1967:160) notes the occurrence of a similar site in the Middle Pecos Valley, and a local rancher described a site with "tipi rings" within the study area along the Arroyo del Macho.

The only other occurrence of this feature type is a single rock ring recorded as IO 38. This is a roughly oval ring of large gypsum chunks 2.7 meters by 1.9 meters in diameter. Associated artifacts included four quartzite flakes, four cores (quartzite, chert, basalt) and a cobble fragment. The origin of the rock ring is uncertain. There is a small rock ring with charcoal inside along one side of the ring with two mesquite branches associated, and the rocks comprising the ring appear to be sitting on the ground surface rather than imbedded into the soil. These attributes indicate a relatively recent construction date. Also, there are several prehistoric sites in close proximity that could account for the lithic debris noted "in association" with the ring. Ultimately, the cultural origin of the feature remains unknown.

The remaining feature type noted during the Abo survey is a possible linear alignment of limestone blocks noted at LA 45459. It is roughly five meters long with a possible continuation indicating an open circular arrangement roughly 10 meters by 7 meters in area. This feature is rather nebulous in appearance and its function or origin is undetermined. It may have functioned as the base of a windbreak or other rudimentary shelter, or possibly the rocks may have served to weight down hides (bison) during processing (c.f. Binford 1983:172).

3.3 DEVELOPMENT OF SITE TYPOLOGIES

This section addresses the variability within the Abo project cultural resources. Included is a discussion of the methodology, and rationale employed in developing the site classification scheme as well as a discussion of the various site types.

The Abo project sites are separated into historic, and prehistoric or aboriginal components. The historic sites are identified by the presence of American, European or non-Native American features or artifacts. An arbitrary date of 1930 (ca. 50 years BP) was chosen as the minimum age for historic sites. This resulted in the elimination of one previously recorded site (AR 2106) represented by a relatively recent trash scatter. Prehistoric or aboriginal sites are identified by the presence of stone and ceramic artifacts and the absence of artifacts of Anglo or non-Native American manufacture. Although several prehistoric sites were recorded which include occasional historic artifacts (typically single cartridge shells, glass or cans), no sites were discovered which are considered protohistoric; that is, aboriginal sites occupied during the historic period. It is possible that some of the Abo sites were occupied after the initial historic contact period. However, the absence of historic or diagnostic artifacts at these sites necessitates their inclusion in the prehistoric or aboriginal category. Occasionally prehistoric sites were noted with recent trash scattered about or dumped in discrete piles. This debris is evidence for the recent use of the area but is not considered old enough to warrant designation as historic components. Also, recent historic (post-1930) campsites and trash scatters were periodically encountered during the survey. All these are characterized by crimp-seam cans and clear glass or other recent debris (e.g. see Eidenbach and Wimberly 1979:265). These locales are not considered to be of sufficient antiquity to warrant site status.

3.3.1 Historic Sites

Two historic sites are documented within the sample units and represent 1.5% of the total number of sites(133). One other historic site (LA 45463) was recorded slightly outside of a sample unit. The paucity of historic sites reduced the need to develop a classification scheme for the Abo sample. However, a tenative classification system for cultural resources is presented at the end of this section.

One historic site (AR2107, HSR 904-4) is tentatively identified as a sheep herders' camp. It is located in Sample Unit 4-22-31-5 and had been previously recorded (Eidenbach and Wimberly 1979:265). This site is situated in a naturally protected sinkhole enclosure and contains a scatter of purple glass fragments, a few metal fragments and strap iron. An indistinct addition to the natural rocky walls of the sink is also associated. The purple glass indicates a use prior to 1920.

The only other historic site (LA 44857) encountered within the sample units is identified as a homestead. This type designation is based on a constellation of features and artifacts including the presence of a stone foundation, a well, a possible trash pit or dugout depression, a possible outhouse pit or trash pit and a scatter of historic debris indicative of domestic activities. The artifacts include purple and green glass seamless bottle necks and solder ring seal cans indicating a site occupancy between AD 1900 and AD 1930. A light scatter of chert and basalt flake debris was also noted at this site. However, the origin and locational integrity of these artifacts is suspect and this site has not been included in the prehistoric site type classification.

Another historic homestead (LA 45463) was located along the crest of a rounded ridge overlooking Huggins Draw. It is slightly outside of Sample Unit 5-25-9-2 and includes two building foundations, two cisterns, two depressions and a scatter of historic trash including a 1933 license plate. The trash indicates an occupation roughly between AD 1920 and AD 1940. Because this site is outside of the sample unit area it has not been included in the analyses.

Another example of a historic temporary camp was noted in Sample Unit 7-23-20-1. This locale included a tent pad, rock alignment, and a scatter of crimp seam cans and clear glass fragments. The tent pad and abundant number of cans indicate extended use of the locale, possibly as a "line camp" or temporary camp associated with cattle or sheep ranching. This locale was not given a site designation as the cans and glass indicate an occupancy post dating AD 1930.

The Abo survey data is considered very underrepresentative of the historic resources anticipated within the study area. Previous research in the general vicinity has documented a variety of historic cultural resources including early towns or villages, ranches, homesteads, dugouts, water control features, corrals, roads or trails and trash scatters (Kemrer and Kearns 1982:13-15, 37; Bond 1979:65-66; Eidenbach and Wimberly 1979:261). The historic resources are representative of occupation of the region by Native American groups (notably Apache and Navajo), Mexican settlers and Anglo ranchers, military forces and homesteaders (Scurlock 1979:195-206; Camilli and Allen 1979; Schaafsma et al. 1967; Stein and Peckham 1974; Phillips Jr. et al. 1981; Bond 1979:65-66).

The paucity of historic sites documented by the Abo survey is presumably due to a great degree by land jurisdiction restrictions. That is, those areas most conducive to historic development (e.g. agricultural land, prime ranching locations, homestead sites) are those areas most likely to be privately owned today and were not therefore included in the sample universe. Those historic resources most likely to be encountered within the sample universe potentially include failed homesteading efforts which have reverted back to public domain and temporary camps associated with ranching activities. The Abo data indicate that incidences of both are relatively rare.

Future classification systems for the historic cultural resources will be dependent upon an expanded data base. However, based on previous work in the project vicinity a tenative classification for the Abo ate sites might include the following:

1. Sedentary Communities:

    These are typically large sites which were the locations of aggregated sedentary social units occupied in both commercial and domestic pursuits. The archaeological manifestation of these sites would include the remains of commercial, residential and possibly industrial structures and related features and cultural debris. These sites should evidence planning in their layout and should potentially contain the remains of streets, sidewalks, water and sewage lines, trash dumps, cemeteries and other

related facilities. This class of sites might potentially be divided into subtypes based on size (e.g., towns versus villages), functional orientation (e.g., an agricultural community versus a manufacturing community), or temporal or ethnic affiliation (e.g., early Mexican community versus late 19th century American community). The town site of Acme (no Laboratory of Anthropology number) in the southeast corner of the survey area and the communities of Puerto De Luna (LA 5201) and Guadalupe (LA 25888) north of the survey area are examples of this site type.

2. Individual Habitation Locales:

   This class of cultural resources includes this sites typically identified as ranches, farms or homesteads. They are locales occupied by small to moderately small, sedentary social groups (e.g., extended family, or ranch families and hired personnel). They are characterized by structured remains; typically residential structures and associated outbuildings (e.g., barns, sheds, dugouts, bunkhouses, outhouses, tack rooms). Additional features anticipated at these sites may include wells, cisterns, corrals, fences, trash dumps, small burial plots, and scatters of historic debris. This site category can potentially be divided into several subtypes based on function (e.g., ranch versus farm) or size. The previously described homestead locales (LA 44857, LA 45463) identified during the Abo survey are examples of this site type.

3. Temporary Camp Locales:

   This is a potentially diverse site category that includes locales established as short term temporary habitations or camps. They are typically small, although situation may have occurred which would have resulted in larger sites of this type (e.g., a ranch round-up camp or military bivouac). The archaeological manifestations of these sites can be expected to vary from simple historic debris scatters to sites evidencing hearth features, temporary shelter features (e.g., tent pads, windbreaks), other miscellaneous features and scattered or clustered historic debris. It is anticipated that this class of sites can be separated into a number of subtypes depending on inferred function size or cultural-temporal affiliation (e.g., ranching related line camps, drive or round-up camps, hunting or recreation related camps, early historic Indian camps). Examples of this site type include the two previously discussed camps (AR 2107/HSR 904-4, and the locale in sample unit 7-23-20-1).

4. Limited Activity or Task Specific Locales:

   This class of sites would include a variety of functionally specific locales representing a diverse set of activities. They would typically be small sites although situations may occur where larger sites are represented (e.g., corral). This category can be expected to contain a variety of subtypes based on functional variability. These could include trash dumps or scatters, ranching related features (e.g., corrals, fences, dipping facilities), petroglyph or pictograph sites, water control

features, and roads or trails. Examples of this site type include the bridge abutments (IF 24) and Bloom Well (LA 33119) in the Two Rivers Reservoir (Phillips, Bandy and Scholz 1981:61,62,65,68).

This list of historic site types does not exhaust the potential variability in this group of sites. Other possible site types might include locales related to industrial activities (e.g., mining) or military activities. Additionally, it is probable that some historic Indian (Apache, Commanche, Navajo) sites will be more appropriately classified within the format established for the prehistoric sites (e.g., temporary camps).

3.3.2 Prehistoric Sites

A total of 130 prehistoric sites are included in the Abo sample.One hundred and nineteen of the prehistoric sites had been recorded during the Abo survey and 11 additional prehistoric sites were previously recorded. The overwhelming majority (103 sites, 79.23%) are aceramic lithic scatters. The remaining 27 sites (20.76%) are sherd and lithic scatters. One of the aceramic sites includes rock ring features which resemble features identified as tipi rings. All of the sites are in open exposed settings; none were situated in rockshelters or overhangs. No sites with evidence of surface or subsurface structures (i.e. masonry or adobe roomblocks, pithouses) were noted, and no rock art sites were discovered. Sites with habitation structures, rock art sites and sites in rockshelters are known to occur in the project area vicinity and will be discussed following a review of the survey sites.

The Abo project sites have been organized into four major type categories based on complexity and on the presence or absence of features and specific artifact classes. These major categories are further divided into a series of subtypes based on the occurrence of specific artifact sets. Table 3.4 identifies the Abo project site types:

Table 3.4
Abo Site Type Categories
(based on surface observation only)

Code	Description
10	1. Multiple Use Locales: These are typically large sites that evidence a variety of different functions (e.g. lithic procurement, tool use or workshop activities, camping-related activities including cooking and food processing, and hunting related tasks). The residue from these activities is generally scattered throughout the "site area" often forming discrete loci or clusters. However, in some instances the cultural debris is manifested as a continuous scatter which tends to obscure specific activity loci. Several different forms of this site type are represented in the Abo survey site inventory.

Table 3.4 (continued)
Abo Site Type Categories

Code	Description
10	1. Multiple Use Locales:
11	A. Sites characterized by lithic source materials, debitage representing all stages of lithic reduction, flaked stone tools, milling equipment, ceramics, hearth features or scattered fire-cracked rock.
12	B. Sites with all IA characteristics excluding ceramics.
13	C. Sites with all IA characteristics excluding ceramics and hearth features or fire-cracked rock.
14	D. Multiple use locales which lack lithic source materials yet include all of the remaining IA characteristics.
15	E. Multiple use locales characterized by discrete loci with different assemblage sets yet lacking hearth features (ceramic and milling equipment are present).
	2. Temporary Camp Locales:
20	These are typically sites characterized by artifact assemblages and features considered indicative of domestic or camping activities (e.g. milling equipment, ceramics, a diversified chipped stone tool assemblage, and cooking or roasting facilities or temporary structure remains). These site types are a common occurrence within the project area. They are divided into a series of different subtypes based on assemblage and feature content and diversity.
21	A. Sites characterized by hearth features or scattered fire-cracked rock, ceramics, milling equipment and a mixed flaked stone tool assemblage.
22	B. Sites characterized by hearth features or scattered fire-cracked rock, ceramics and a mixed flaked stone tool assemblage yet lacking milling equipment.
23	C. Sites characterized by hearth features or scattered fire-cracked rock, milling equipment and a mixed flaked stone tool assemblage yet lacking ceramics.
24	D. Sites characterized by hearth features and a mixed flaked stone tool assemblage yet lacking milling equipment and ceramics.

Table 3.4 (continued)
Abo Site Type Categories

Code	Description
25	E. Sites characterized by milling equipment and a mixed flaked stone tool assemblage yet lacking evidence of hearth features and ceramics.
26	F. Sites characterized by ceramics, milling equipment, and a mixed flaked stone tool assemblage yet lacking evidence of hearth features.
27	G. Sites characterized by ceramics and a mixed flaked stone tool assemblage yet lacking hearth features and milling equipment.
28	H. Single site characterized by rock ring features ("tipi rings") and a mixed flaked stone tool assemblage; lacking evidence of hearth features, ceramics and milling equipment.
	3. Lithic Procurement and Workshop Locales:
30	These are sites characterized by immediate access to lithic materials suitable for the production of flaked stone tools, and by primary reduction debitage and a mixed flaked stone tool assemblage. Hearth features, ceramics and milling equipment are absent from these locales (unless previously identified as multiple use locales). Variability in this class of sites is manifested primarily in the lithic source materials and in the extent and intensity of use. The figures presented for the subtypes are based on the Abo site data only and further work may necessitate a reorganization. That is, it is probable that additional data will demonstrate a continuum in site size and artifact density with some overlap between subtypes.
31	A. Relatively large site and assemblage size (greater than 75,000 m^2 and more than 600 artifacts).
32	B. Relatively moderate site and assemblage size (greater than 7,000m^2 and more than 100 artifacts). One type 2B site covers an area of roughly 11,000 m^2 yet contains fewer than 100 artifacts and represents an example of the overlap between the subtypes.
33	C. Relatively small site and assemblage size (less than 7000m^2 and fewer than 100 artifacts).

Table 3.4 (continued)
Abo Site Type Categories

Code	Description
	4. Limited Activity Locales/Task Specific Campsites:
40	These sites are typically characterized by small assemblage size and diversity. The assemblages include flake debris and a variety of flaked stone tools. They are separated into a series of subtypes based on assemblage content.
41	A. Sites characterized by flake debris and cores only.
42	B. Sites characterized by flake debris, cores, utilized flakes and/or scraping implements only.
43	C. Sites characterized by flake debris, bifaces and/or projectile points only.
44	D. Sites characterized by flake debris (cores also), bifaces, biface reduction flakes, or projectile points along with a mixed flaked stone tool assemblage.
45	E. Sites characterized by flake debris, (cores), and a mixed flaked stone tool assemblage exclusive of projectile points, bifaces or biface reduction flakes.

The organization of the sites into this format is a combination of statistical and subjective analyses based on the project results, review of other survey reports in the general region (Stuart, et al. 1975; Wimberly and Rogers 1977; Eidenbach and Wimberly 1979; Bond 1979; Phillips et al. 1981; Clifton 1973; Ford and Sciscenti 1982), and on experience gained on other BLM sponsored Class II surveys elsewhere (Kearns et al. 1982; Reynolds et al. 1983). The classification is considered a usable, realistic ordering of the cultural resources vis-a-vis management needs and behavioral parameters. That is, this approach provides a mechanism to easily segregate the project's cultural resources and facilitates discussion of the sites in a functional framework (albeit coarse), thereby providing a format to more effectively visualize and evaluate the land use strategies of the resident aboriginal populations. The classification assumes that different artifact types are representative of differing functions and, either separately or in combination with other artifact types, are representative of specific tasks or activities. The variable occurrence of these activities in space generates the different assemblages encountered in the archaeological record. These, in turn, are more or less equated with site type designations. However, it is noted that because the functional parameters of some artifact types overlap (e.g. utilized flakes and bifaces or scrapers) or may be ambiguous (e.g., heavily worn rounded edge cobble uniface), and because functions are not mutually exclusive between site types, the classification system is more structural than functional. This may be particularly true for the Type 3 quarry-workshop sites and some of

the Type 4 limited activity sites, particularly Type 4E. The only distinction between some sites in these two types may be the availability of lithic resource materials and intensity of use. Also, differentiation between a temporary camp locale and a limited activity or task specific locale is at times a tenuous distinction. This is particularly true for some of the Type 2D, 2G, 4D and 4E sites. Size, density and diversity are variables which need to be examined to further refine the relative relationships between sites of these Types. Another potential problem domain is the differentiation between the structure of sites periodically reused through time (palimpsest sites), often for differing purposes, and sites at which contemporaneous activities or multiple social units were spatially segregated. This is often an elusive task, particularly at the Class II survey level.

Following the establishment of the site type categories the sites were subjectively assigned to the type they most closely approximated. Table 3.5 lists the attributes used in this analysis. In doing this several operational procedures were followed. This essentially involved the combining of functionally equivalent attributes. Included was the equating of sites containing fire-cracked or burned rock with sites containing discrete hearth features; sites with biface reduction flakes and indeterminate biface/projectile point fragments with sites containing bifaces; and, sites with hammerstone spalls with sites containing unmodified hammerstones. Also, several lithic artifact categories were combined as analytical units. This includes handstones and milling stones which operate together and form a functional unit. Another group identified as small scraping, chopping or planing implements includes the various small to medium sized marginally or facially retouched flake uniface implements, marginally or facially retouched flake biface implements identified as scrapers rather than biface knives, and small pebble uniface and biface implements. One other group identified as large scraping, chopping or planing implements includes the large cobble uniface and biface implements and artifacts identified as angular choppers. These artifacts were lumped together because of the ambiguity inherent in their functional parameters. However, the large versus small differentiation is considered a relatively meaningful distinction which may be indicative of functional variabilities (e.g. large retouched tools are considered more likely to represent chopping, or heavy rough planing or scraping tasks; while the smaller retouched tools are considered more indicative of lighter, more specific scraping, cutting or planing tasks). In addition, one other site characteristic utilized to identify site type variability was the presence or absence of lithic tool material sources at a site. This was considered an important variable for differentiating the quarry-workshop site types.

The choice of using the presence or absence of specific artifact classes to differentiate site types as opposed to other techniques (e.g. percentages of tool classes, locational variables) was tempered by several considerations. First, the various elements that constitute key variables in the Abo site type classification (e.g. ceramics, milling equipment, hearths) are considered important, easily recognized indicators of different activities (as opposed to less diagnostic artifacts - e.g. cores, marginally retouch flake uniface tools, utilized flakes and cobble unifaces). Also, these variables have demonstrated utility in differentiating site variability elsewhere in southern New Mexico (e.g., Wimberly and Rogers 1977:8-87). Secondly, since the Abo survey data

constitutes a first approximation of the cultural resource variability in the study area, it was felt that the site classification system should be realistically manageable and not so cumbersome as to impede or negate any meaningful discussion, comparison, or analysis. This is not say that variables such as site size, artifact density, percentage of different flake and tool types and material diversity are not important; they are. However, to have incorporated a system using those variables for our initial classification would have led to a proliferation of different site types with little analytical value. These other site attributes are considered in further detail in the following section devoted to a discussion of the various site type categories.

The organization of the Abo project site type analysis was non-quanitative and therefore discriminant function analysis could be used to qualitatively evaluate the distinctness of the different types. Discriminant function analysis is a technique that will statistically determine the distinctiveness between two or more groups or cases. Individual sites are the cases in the analysis of the Abo data.

The variables (lithic tool types, ceramics, features and lithic tool material availability) monitored during the survey and incorporated into the site type analysis represent characteristics by which the groups were expected to differ. The object of discriminant analysis is to weigh and linearly combine the variables in the different groups so that the groups are forced to be as statistically distinct as possible. The result is the formation of one or more linear combinations of discriminating variables called "discriminant functions". These functions are formed in such a way as to maximize the separation of the groups. The maximum number of groups is typically equal to the number of discriminating variables (Klecka 1975); however, for the purposes of this analysis a maximum of four groups was specified.

Once the discriminant functions are generated, they are used to analyze the original set of cases to determine how many were correctly classified. In addition, the analysis will reclassify those cases incorrectly classified.

For the discriminant function analysis, a total of 18 site characteristic variables were monitored on a presence/absence basis. These are listed in Table 3.5. The assigned site type and the site characteristic variables were coded for each site recorded by the Abo sample survey and compiled into a computerized data file. Because of some ambiguity in the data, observations for all 18 variables for 13 sites could not be made. Also, the two historic sites recorded within the survey sample units were not appropriate to this analysis. Consequently, 117 of the 130 sites were coded.

The data were first subjected to stepwise discriminant function analysis. This analysis identified those site characteristics which contribute significantly to differentiating the four major site types from one another. This analysis also specifies the relative importance of each variable regarding site type differentiation. The outcomes of the stepwise analysis are presented in Table 3.6. As illustrated in this table, only six of the 18 variables proved to be important segregators of site type. Three of these, the presence or absence of hearths/fire-cracked rock, milling equipment and ceramics were explicit criteria employed to generate the site types. The remaining three

Table 3.5
List of Variables Utilized to Evaluate the Site Type Classification Scheme

No.	Variable Description	No.	Variable Description
1	Milling Equipment	10	Angular Hammerstones
2	Ceramics	11	Non-Angular Hammerstones
3	Projectile Points	12	Cores
4	Bifaces (or Biface debitage)	13	Primary Flakes
5	"Light" Cutting/Scraping Tools	14	Secondary Flakes
6	"Heavy" Cutting/Scraping Tools	15	Tertiary Flakes
7	Drills or Borers	16	Angular Debris
8	Utilized Flakes	17	Hearths or Fire-cracked Rock
9	Utilized Cores	18	Lithic Source Materials

significant variables, the presence/absence of non-angular hammerstones, lithic source materials and drills or boring tools, were not explicit criteria for the recognition of site types. Thus the stepwise analysis has identified three additional characteristics which differentiate the site types from one another. Also shown in Table 3.6 are the descriptive statistics for the variables. Two measures, the f-ratio and Wilks' Lambda, both of which compare within-group to between-group variation, were used. The acceptable level of confidence that a given variable contributed significantly more to between-group variation than within-group variability was set at 85% ($p \leq 0.15$). The table lists the six significant variables in descending order of importance, and indicates that hearths/fire-cracked rock and milling equipment were far more important variables than the remaining four.

Table 3.6
Summary of the Stepwise Discriminant Analysis Identifying the Significant Site Type Characteristics Variables

Variable	F-Ratio	Prob.> F	Prob.> Lambda
Hearths/Fire-cracked Rock	38.21	0.0001	0.0001
Milling Equipment	21.63	0.0001	0.0001
Non-Angular Hammerstones	6.46	0.0005	0.0001
Ceramics	5.11	0.0025	0.0001
Lithic Source Materials	3.38	0.0207	0.0001
Drills/Borers	2.41	0.0699	0.0001

The data were then subjected to reclassification analysis. In this procedure, the raw data for each site are passed through the four discriminant function equations to evaluate how well the variables assessed to be significant in fact perform in recognizing the individual members of the four site types. The outcomes of this reclassification analysis are presented in Table 3.7. The overall rate of correct reclassification success is high, for 88.9% of the sites were correctly classified into the site type that they were originally assigned.

As shown in this table, the poorest rate of correct reclassification was achieved for multiple use locales (site Type 1). This is not surprising, for as will be subsequently discussed this kind of site is often difficult to distinguish from large encampments (site Type 2). Note that the misclassified Type 1 sites fell into the Type 2 category.

Table 3.7
Results of the Reclassification Analysis for the Four Major Site Types

Sites from	were classified into site type:								
Site Type:	Type 1	(%)	Type 2	(%)	Type 3	(%)	Type 4	(%)	Totals
1. Multiple Use Locales	2	(40)	3	(60)	0	(0)	0	(0)	5
2. Encampments	2	(3)	58	(91)	1	(2)	3	(5)	64
3. Lithic Procurement Loci	0	(0)	0	(0)	8	(73)	3	(27)	11
4. Limited Activity Loci	0	(0)	0	(0)	1	(3)	36	(97)	37

Another analysis was conducted to illustrate the roles that the six significant variables play in differentiating the four site types from each other. This information is presented in Table 3.8. Hearths or fire-cracked rock occur with high incidence in the behavioral complex Type 1 and 2 sites and are completely absent from site Types 3 and 4. The same pattern holds for milling equipment and ceramics. Non-angular hammerstones associated with lithic reduction activities occur with higher incidence at multiple use locales (Type 1) and lithic procurement (Type 3) loci. Correspondingly, these site types are more likely to be situated in areas which contain lithic resources than encampments (Type 2) and limited activity (Type 4) loci. Finally, drills/boring tools occur with proportionately greater incidence at multiple use locales (Type 1) than at any other site type. An examination of the average incidence of these six characteristics arrays the four site types in terms of behavioral complexity, with Type 1 sites being the most complex and Type 4 being the least.

In summary, the discriminant analyses of the on-site archaeological characteristics identifies the analytical utility of the site typology developed from the Abo sample survey data. The six variables which most strongly differentiate the site types on a presence/absence basis are recommended as minimal observations for future inventory work in the Abo region.

Table 3.8
Distribution of the Significant Characteristics Among the Major Site Types

Variable Description	TYPE 1 Multiple Use		TYPE 2 Encampment		TYPE 3 Lithic Procurement		TYPE 4 Limited Activity	
	Absent (%)	Present (%)	Absent (%)	Present (%)	Absent (%)	Present (%)	Absent (%)	Present (%)
Hearths/FCR	2 (40)	3 (60)	18 (28)	47 (72)	11 (100)	0 (0)	38 (100)	0 (0)
Milling Equipment	0 (0)	5 (100)	29 (45)	36 (55)	11 (100)	0 (0)	38 (100)	0 (0)
Non-Angular Hammerstones	2 (40)	3 (60)	41 (63)	24 (37)	6 (54)	5 (46)	35 (92)	3 (8)
Ceramics	2 (40)	3 (60)	45 (69)	20 (31)	11 (100)	0 (0)	38 (100)	0 (0)
Lithic Resources	1 (20)	4 (80)	38 (59)	27 (41)	0 (0)	11 (100)	20 (53)	18 (47)
Drills/ Borers	3 (60)	2 (40)	60 (92)	5 (8)	10 (91)	1 (9)	36 (95)	2 (5)
AVERAGE	1.7 (33)	3.3 (67)	38.5 (59)	26.5 (41)	8.2 (74)	2.8 (26)	34.2 (90)	3.8 (10)

3.3.3 Site Classification

Superficially, the 130 Abo project prehistoric sites (including the 11 previously recorded prehistoric sites) represent a relatively limited variety of types. However, there is a considerable amount of diversity evident within each type. Lithic scatter sites comprise the overwhelming majority (79.23%) of the cultural resources encountered; sherd and lithic scatter sites comprise the remainder (20.76%). As previously outlined, the Abo sites are organized into four primary type categories with subdivisions within each. Table 3.9 lists the number and percent of sites and the cultural-temporal affiliation for each site type category. The site type categories are considered convenient analytical groupings of the cultural resources. The type designations are based on field identification of observed assemblages and features. A certain amount of distortion (error factor) is probably introduced through differential exposure (deposition, erosion, and ground cover), previous collecting and intensity of sampling. Even given this potential skewing the Abo project data base is considered an adequate and realistic representation of the diversity inherent in the cultural resources of the study area.

The cultural resources are viewed as a continuum ranging from task specific limited activity locales to small temporary camps, large reoccupied extensive camp sites and multi-function locale, and general use areas. In many instances the differences are viewed as a matter of degree, not kind, The diversity within and among the various site categories is measured by the variability in the artifact assemblages, features, site structure, size, and density.

The following discussion addresses this diversity. Table 5.9 shows the number and percent of sites and the cultural temporal affiliation and Figures 3.13 through 3.15 illustrate the distribution of site type categories for the project area.

3.3.3.1 Large Multiple Activity Locales: Site Type 1

This site type is represented by five examples, all somewhat different. This diversity is summarized in Table 3.10 and discussed below.

These sites appear to represent locales that were reused through time for mixed purposes. They are differentiated from large multiple-loci temporary camp sites and large lithic procurement-workshop sites on the basis of the observed internal diversity.

Sites LA 44680 and LA 44876 represent Pecos River Blackdom Terrace sites characterized by an emphasis on lithic procurement and workshop (limited activity tool use) activities. Both include hearth features or fire-cracked rock and milling equipment indicating additional use as food processing and temporary camp sites.

They are differentiated by the presence of ceramics at LA 44860 (site Type 1A) and their absence at LA 44901 (site Type 1B). This may be indicative of differing use through time (i.e. preceramic versus ceramic period occupancy)

Table 3.9
Number and Percent of Sites and the Cultural Temporal Affiliation for Each Site Type Category
(N = 130)*

Site Type	Number of Sites	(%)	Cultural-Temporal Affiliation
1: A-E	5	3.84	1 - undetermined
			3 - Late Archaic - Early Formative
			1 - Formative
2: A**	10	7.69	1 - early - middle Archaic
			2 - Late Archaic
			2 - Late Archaic - Early Formative
			4 - Post 18 Mile phases
			1 - Post Mesita Negra phases
			1 - Roswell phase
			1 - Roswell - Post Roswell phase
			2 - Formative
B	4	3.07	1 - Formative
			1 - Post Late 18 Mile phase
			1 - Formative
			1 - Roswell - Post Roswell phase
C***	16	12.31	8 - undetermined
			1 - Late Paleoindian - Early Archaic
			1 - Middle Archaic
			2 - Late Archaic
			3 - Late Archaic - Early Formative
			3 - Mesita Negra phases
			1 - McKenzie - Post McKenzie phase
			1 - Late Formative - Post Formative
D****	21	16.15	14 - undetermined
			1 - Late Paleoindian
			1 - Early Archaic
			3 - Late Archaic
			3 - Late Archaic - Early Formative
			1 - Formative
			1 - Post-Formative
E	7	5.38	6 - undetermined
			1 - Middle Archaic

* Total includes 119 Abo survey sites and 11 previously recorded sites.
** 14 components
*** 18 components
**** 24 components

Table 3.9 (continued)
Number and Percent of Sites and the Cultural Temporal Affiliation for Each Site Type Category
(N = 130)

Site Type	Number of Sites	(%)	Cultural-Temporal Affiliation
2: (continued)			
F	6	4.61	1 - undetermined 1 - Late Archaic - Early Formative 3 - Post Late 18 Mile phase 1 - Post Late Mesita Negra phase
G*	5	3.84	1 - Late Archaic - Early Formative 1 - Formative 2 - Post 18 Mile phase 2 - Roswell phase
H	1	0.77	1 - Late Archaic/Formative (?)
subtotal	70	53.85	
3: A	7	5.38	undetermined
B	4	3.08	"
C	1	.77	"
subtotal	12	9.23	
4: A	1	0.77	undetermined
B	9	6.92	"
C	1	0.77	"
D	17	13.08	13 - undetermined 2 - Late Archaic 1 - Late Archaic - Early Formative 1 - Late Formative - Post Formative
E	11	8.46	undetermined
? **	4	3.07	"
subtotal	43	33.08	
TOTAL	130	100.00	

* 6 components

** The Type 3 and 4 subtype

or by slight differences in the type of use each received. That is, each could have been used during the ceramic period, although only one (LA 44860) was the scene of ceramic vessel use. Another differentiating variable is the relative percentages of flakes and tools (flake-tool ratio) noted at each site (Table 3.10). This may be indicative of differing emphasis on tool production and use or may represent sampling bias. At both locations there is a generally continuous distribution of cultural debris across the site area. However, the hearth features and milling equipment at LA 44901 appear more clearly segregated than at LA 44860. Unfortunately, an undetermined portion of LA 44806 has been impacted by sand and gravel quarry operations thereby destroying any evidence of spatial segregation of activities that may have existed in that area.

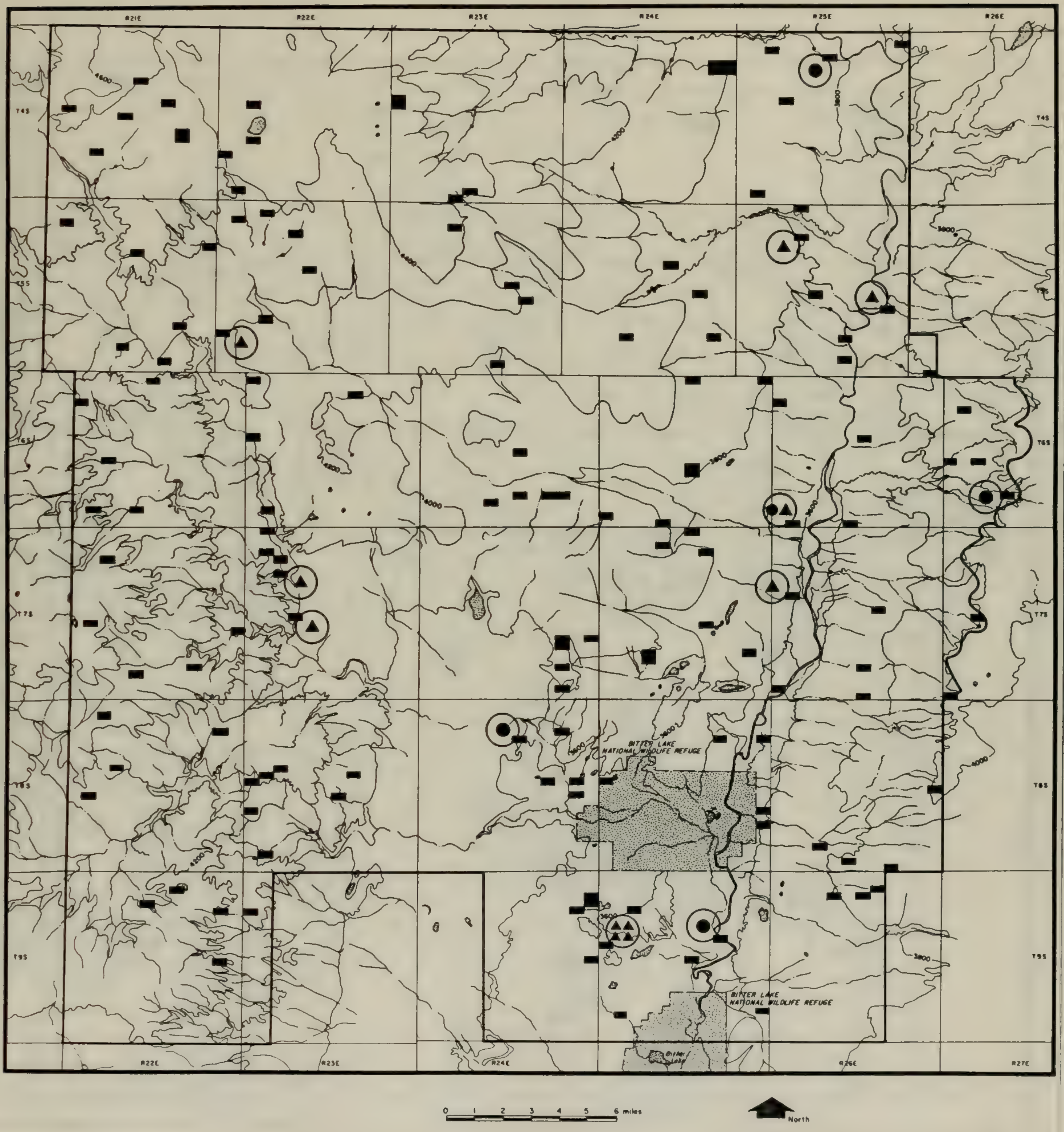
Table 3.10
Large Multiple Use Locale (Site Type 1) Variability

Site	Size (m^2)	Estimated Total* Assemblage Size	Flake-Tool Ratio**
LA 44860	27,000	783	2.21
LA 44876	33,600	820	23.11
LA 45449	264,000	18,251	4.13
LA 45484	400,000	22,962	10.92
LA 44901	175,000	3,000	2.00

* Based on sample transect data
** Flake frequency divided by total frequency

Another Pecos River Blackdom Terrace site (LA 45449) is characterized by an extensive lithic scatter indicative of intensive lithic procurement and workshop activities. In addition, the presence of milling equipment indicates further use of the area for camping or food processing activities. Also, the presence of a projectile point indicates use of the locale for hunting-related activities (e.g. retooling, staging). Although there is a general scatter of lithic debris throughout the site area, the distribution and density of cultural debris varies considerably (Figure 3.16). Figures 3.17 and 3.18 illustrate the variability in density and assemblage content in two of four of the sample transects monitored at this site. Sample transect 1 is illustrative of a moderate density lithic scatter workshop locale and a temporary encampment where hearth remains are not evident. By itself this locus would be identified as a site Type 2E temporary camp locale. Sample transect 2 contains milling equipment and miscellaneous chipped stone tools and presumably represents a temporary camp locale where food processing and a considerable amount of lithic reduction and workshop activities took place. Note the differences in the intensity of use manifested by each of these areas. Sample transect 3 also contains milling equipment and a diversity of chipped stone tools and may have been part of the encampment represented at sample transect 2. If isolated, sample transects 2 and 3 would also be identified as site Type 2E temporary camp locales. Sample transect 4 was located in an area of abundant terrace gravels (cobbles) and is characterized by numerous cobble

Figure 3.13
Distribution of Type 1 and 3 Sites in the Abo Project Study Area
(Circled Symbols Specify Site Type Frequencies)



● Type 1
▲ Type 3

Figure 3.14
Distribution of Type 2 Sites in the Abo Project Study Area
(Circled Numbers Specify Sample Unit Site Frequencies)

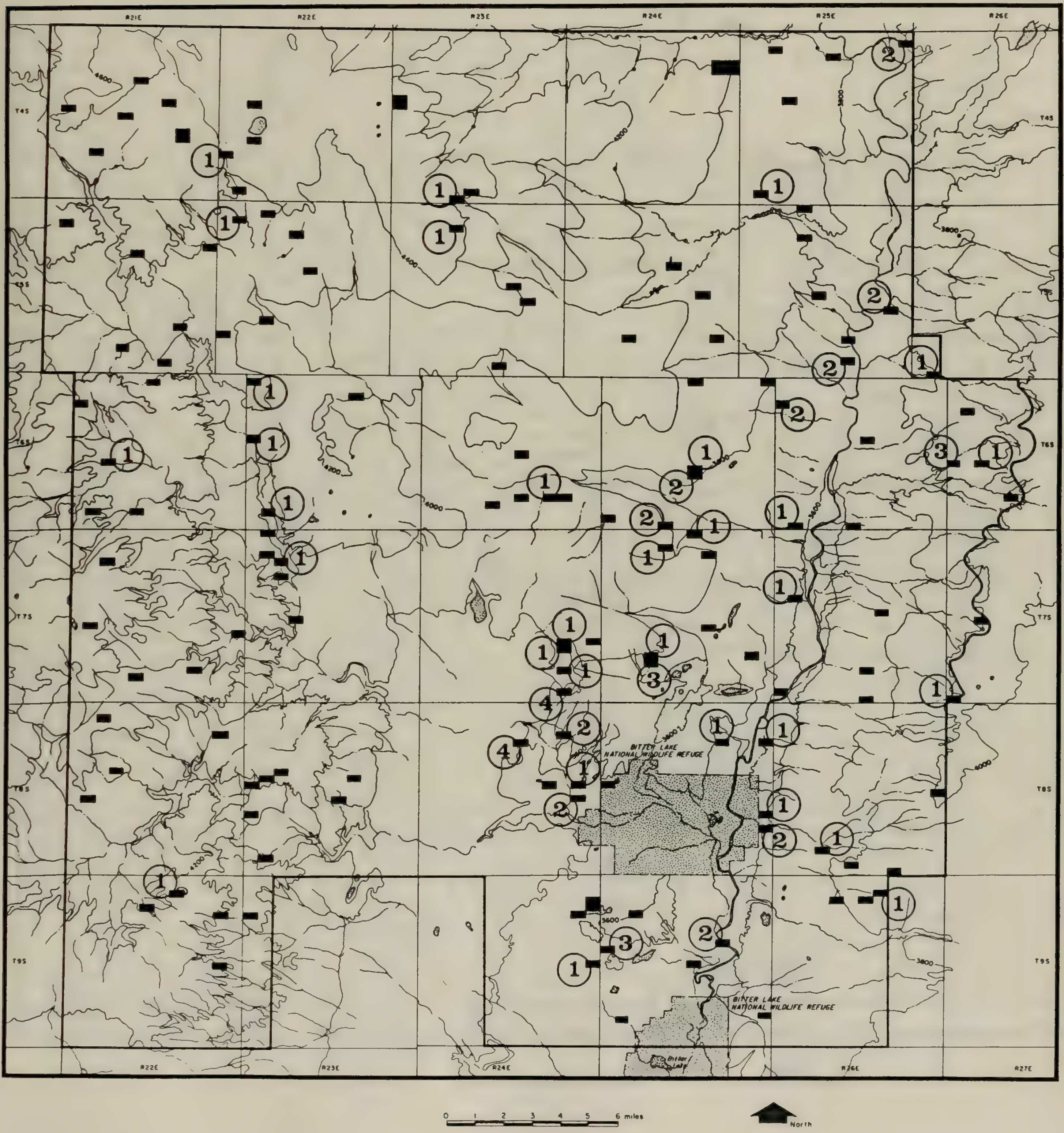
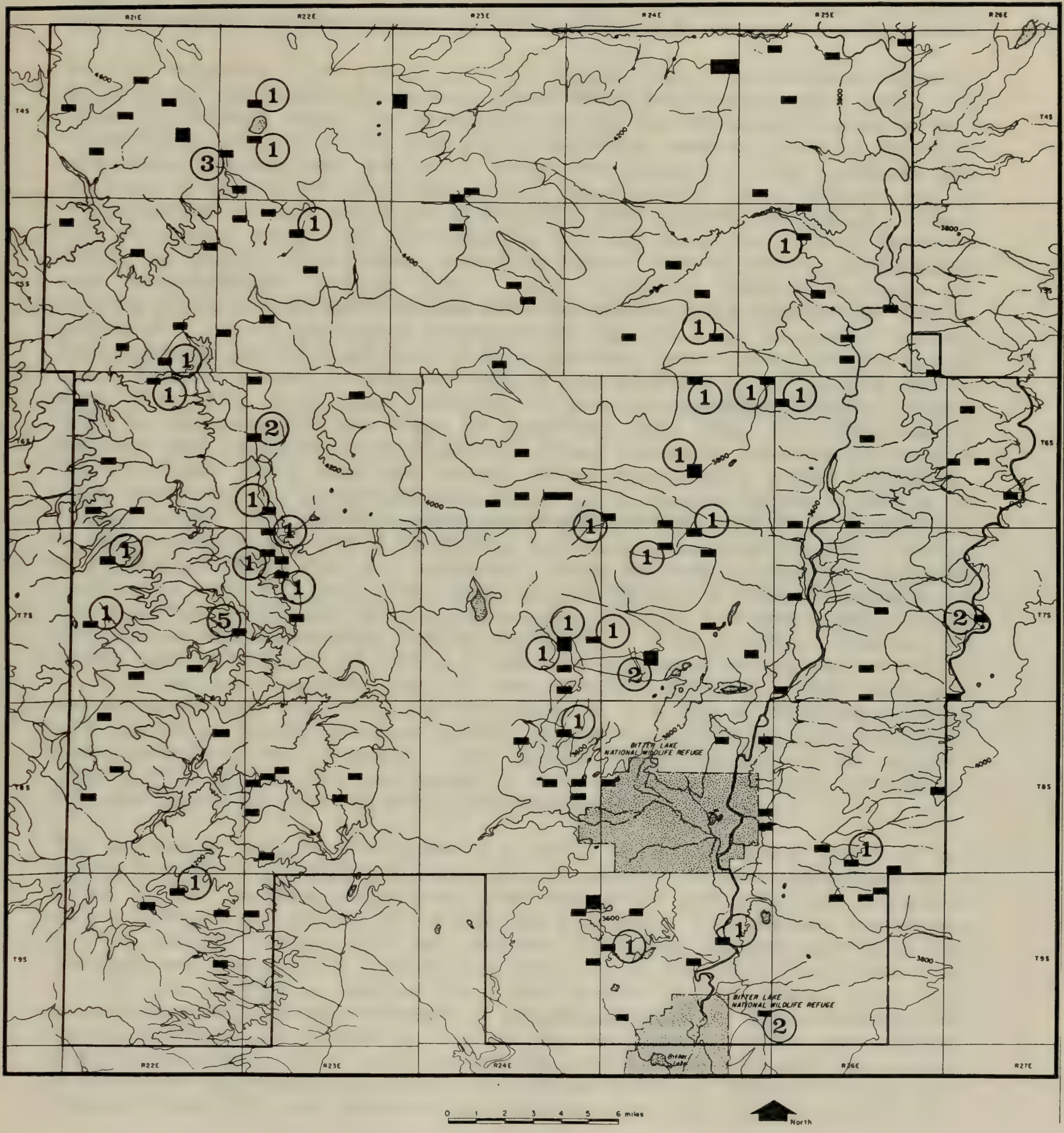


Figure 3.15
Distribution of Type 4 Sites in the Abo Project Study Area
(Circled Numbers Specify Sample Unit Site Frequencies)



and pebble cores, and several hammerstones and a number of retouched flake and cobble tools. It appears to have been part of a larger area where lithic procurement and tool manufacture and use activities were conducted. If isolated, the density and diversity of the cultural debris sampled at this locus would be considered a representative portion of a Type 3A site. No ceramics, observable hearth features or fire-cracked rock were noted at this site.

The two remaining Type 1 sites are both located away from the Pecos River in areas where no gravel deposits or other lithic source materials occur. LA 45484 is situated below the sandstone rim of the Mescalero Pediment in a broad rincon created by the converging headwater washes of one of the major tributaries draining into the Pecos River from the east. This extensive site occupies a series of sand and sandy loam-capped spur ridges and is characterized by a general light to moderate lithic scatter throughout. There are also areas within the site characterized by ceramics, hearth features, milling equipment, flake debris, and flaked stone tools in various combinations and concentrations (Figure 3.19). The variability evident between the various clusters indicates that this area was differentially utilized for diverse purposes. Two of the sample transects (#1 and #3) used to monitor density and diversity are representative of the temporary camp locales present at this site. Sample transect 1 (Figure 3.20) is characteristic of a Type 2A temporary camp site, while sample transect 3 and its immediate vicinity (Figure 3.21) is characteristic of a Type 2F temporary camp site. The third sample transect (#2) contains an abundance of biface reduction, tertiary and minute retouch flakes along with two utilized flakes and several biface fragments. This assemblage is considered indicative of a hunting-related retooling or staging locale. The activities represented are distinct from those represented at sample transects 1 and 3 (a pinflag was noted at sample transect 2 and it is considered likely that any projectile points or complete bifaces originally there have been collected). By itself sample transect 2 would be considered representative of a Type 4D site. However, a milling slab was noted roughly five meters away essentially making the locale a Type 2E site. Whether the milling slab was associated with the activities performed at sample transect 2 or represents a separate use of the area is unknown. The composite impression is that LA 45484 was the scene of a series of differing activity sets including limited or task specific activities, hunting-related activities, seed processing and roasting. The spatial characteristics of the artifact scatter, the setting and the nature of the assemblage diversity distinguish this site type (1D) from the other multiple-use locale types.

The remaining multiple use locale, LA 44876, is located on a series of low ridges and knolls bordering a broad grassy valley. It is characterized by a series of four spatially segregated lithic and sherd and lithic concentrations with a sparse flake scatter throughout the site area. The relative sparseness of this general scatter and the discrete clustering of the individual loci distinguishes this type of multiple use locale (Type 1E) from the others. All of the loci contain a scatter of flake debris and a mixed stone tool assemblage, and all lack evidence of hearth features or fire-cracked rock. Milling equipment is present at two of the loci, one of which also includes plainware ceramics. The remaining two loci contain only chipped stone tools. If identified separately they would be representative of temporary camp sites (Types 2E and 2F); and limited activity locales campsites (Types 4D and 4E).

Figure 3.16
Sample Unit 4-25-3-7 and LA 45449, A Large Multiple Use Site Type 1C

This is an example of one of the extensive lithic scatter sites situated on the Blackdom Terrace overlooking the Pecos River. Much of the site area is capped with terrace gravels. The density of cultural debris corresponds somewhat to the density of the gravels. Variability in the amount and kind of lithic debris was monitored by four sample transects placed in different areas of the site (Figures 3.17, 3.18).

Artifact Key for LA 45449:

•	flake
⧫	utilized flake
△	flake "scraper"
▲	biface "scraper"
□	unmodified cobble hammerstone
⚬	handstone
⊕	pebble microcore
◭	pebble uniface "scraper"
▽	cobble uniface "scraper"
◐	cobble uniface "core/chopper"
▼	split cobble uniface "core/scraper"
◨	cobble biface "core/scraper"
◧	cobble biface "core/chopper"
○	core
▴	biface base

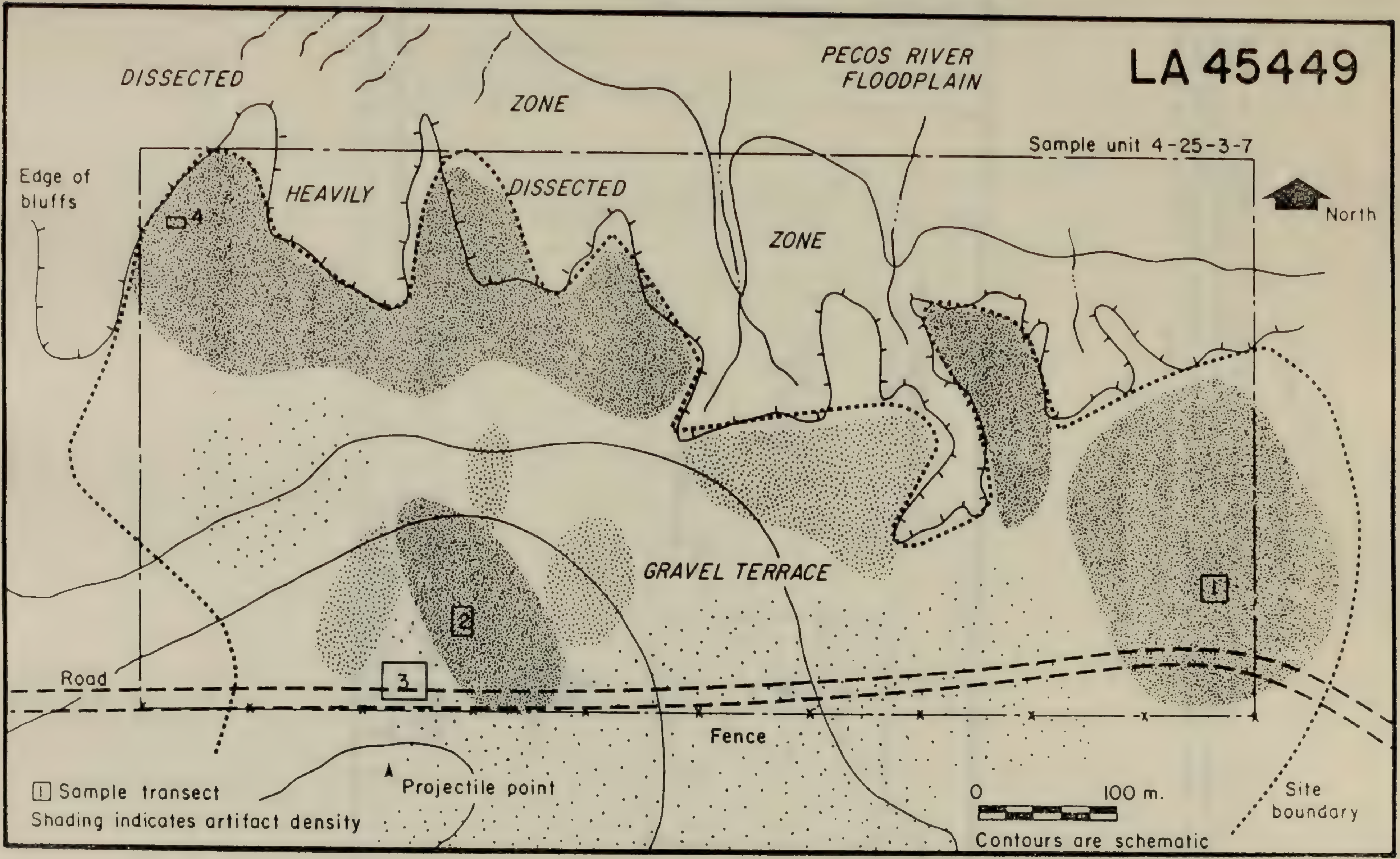


Figure 3.16 (continued). Sample Unit 4-25-3-7 and LA 45449, A Large Multiple Use Site Type 1C. (see Figure 3.17 and 3.18 for maps of sample areas 1 and 2)

Figure 3.17
LA 45449 Sample Transect #1

This is considered a moderately light lithic scatter within the site area. There is a general scatter of flake debris surrounding the sample transect. The two tools noted outside the transect are indicated. By itself this locale would be identified as a Type 2E temporary camp.

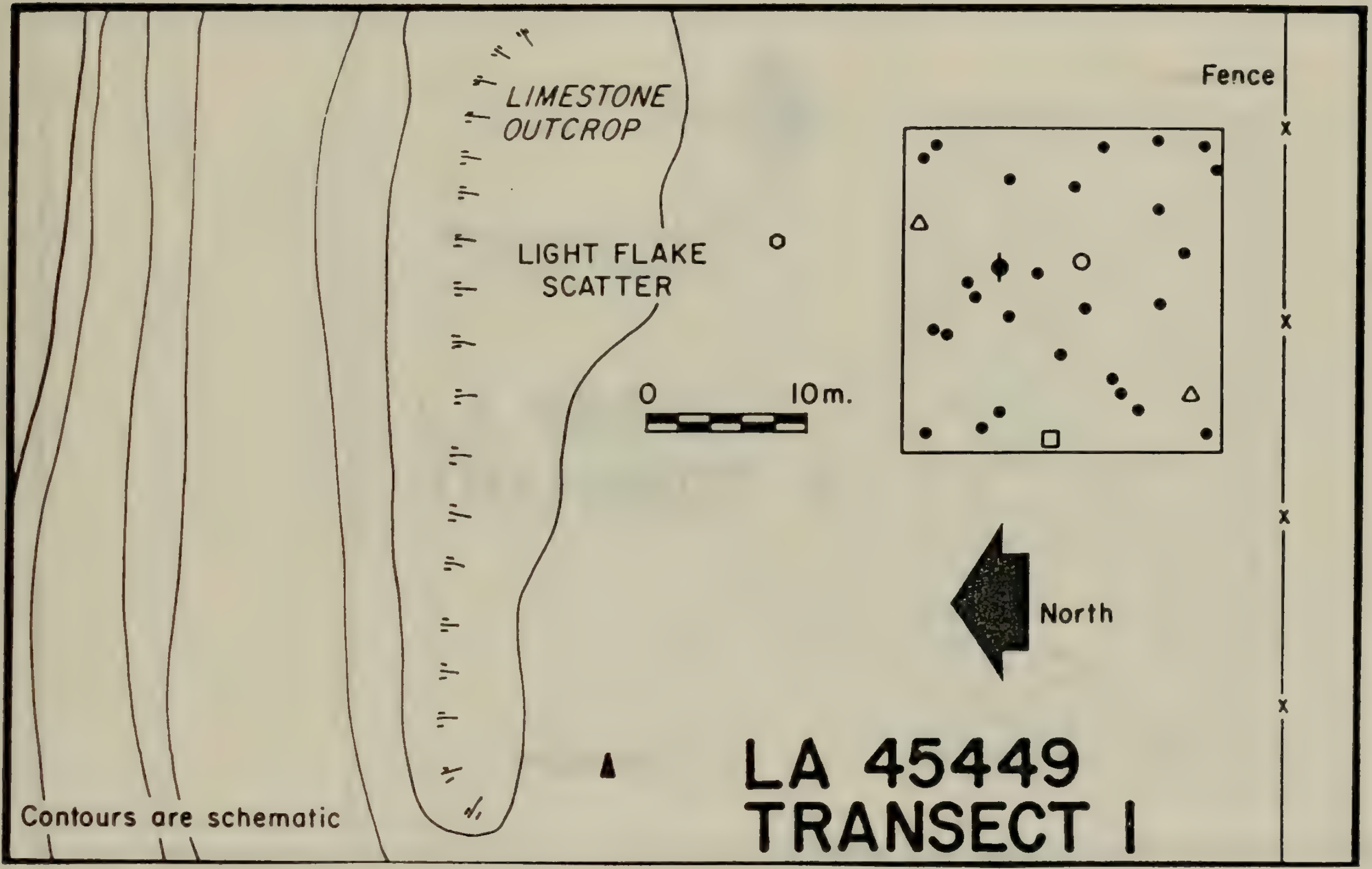
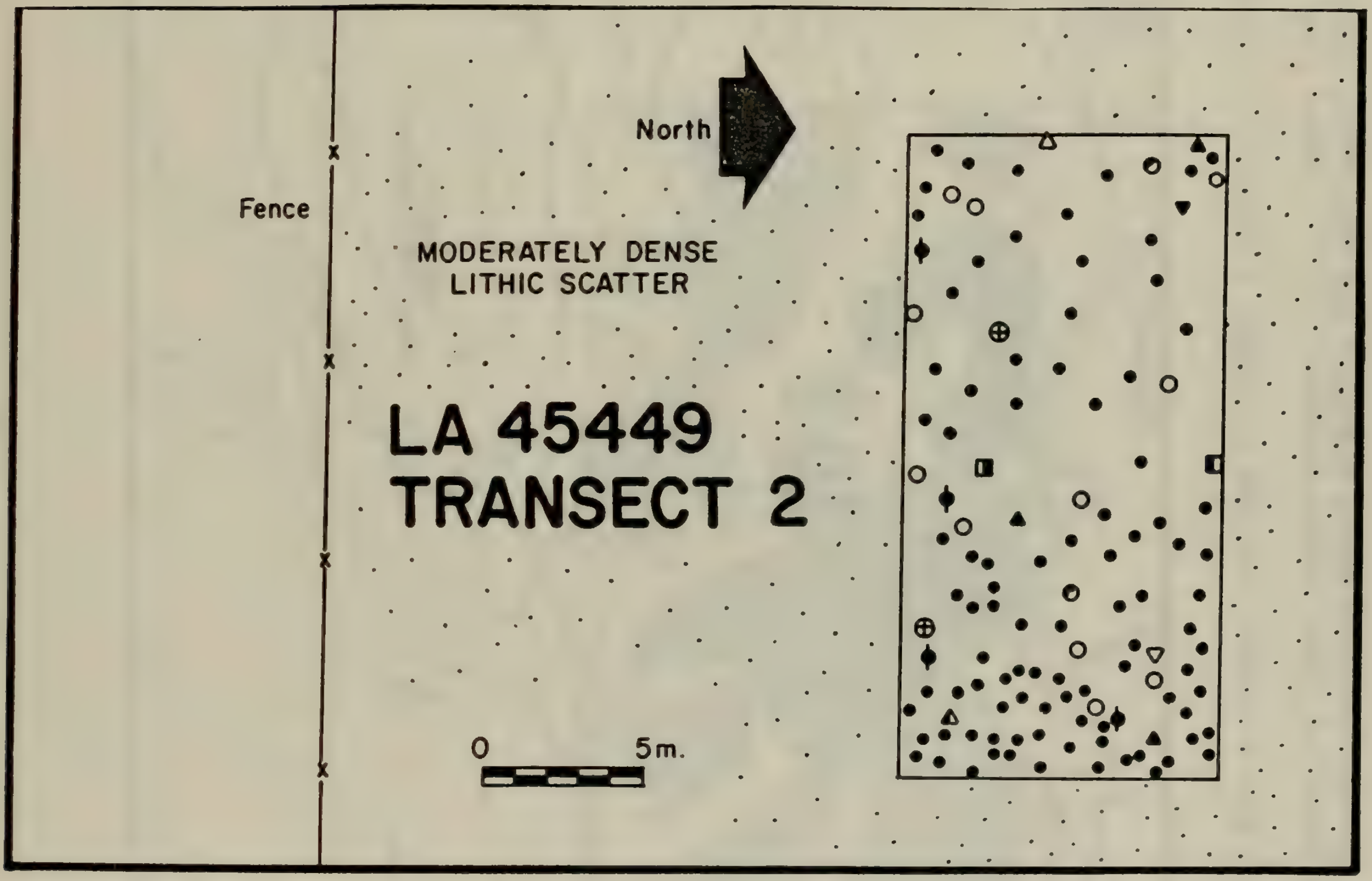


Figure 3.18
LA 45449 Sample Transect #2

This is considered a moderately dense lithic scatter within the site area. There is a general scatter of lithic debris (tools and flakes) surrounding the sample transect. By itself this locale would be identified as a Type 2E temporary camp.



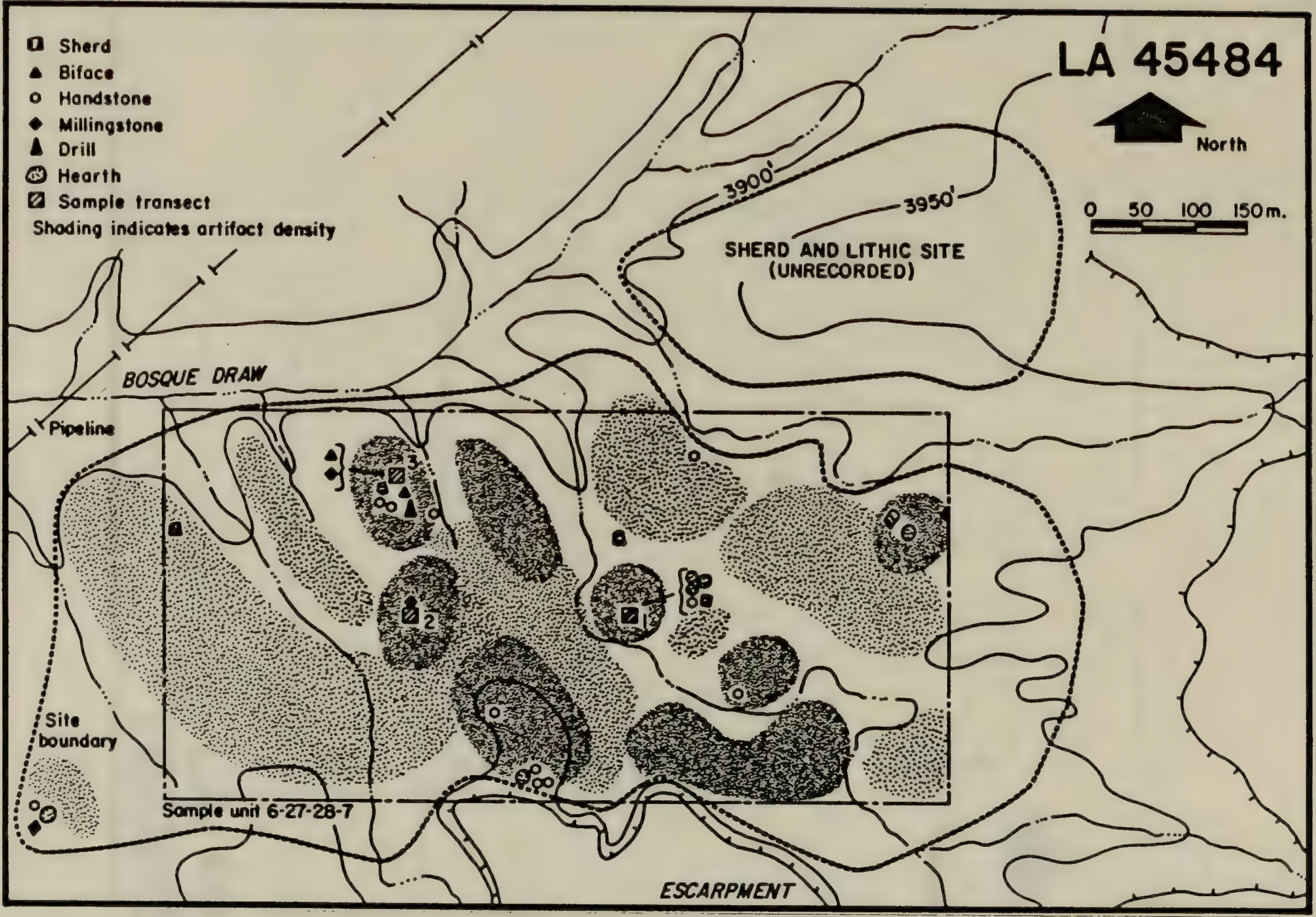


Figure 3.19. Sample Unit 6-27-28-7 and Site LA 45484, a Large Type 1D Multiple Use Locale.

This extensive site was monitored by three sample transects, (e.g., Figure 3.20, 3.21) and is characterized by an abundance of lithic debris with scattered sherd and lithic loci and hearth features.

Figure 3.20
LA 45484 Sample Transect #1

This is an example of one of the hearth loci within the site area. By itself it would be identified as a Type 2A temporary camp locale.

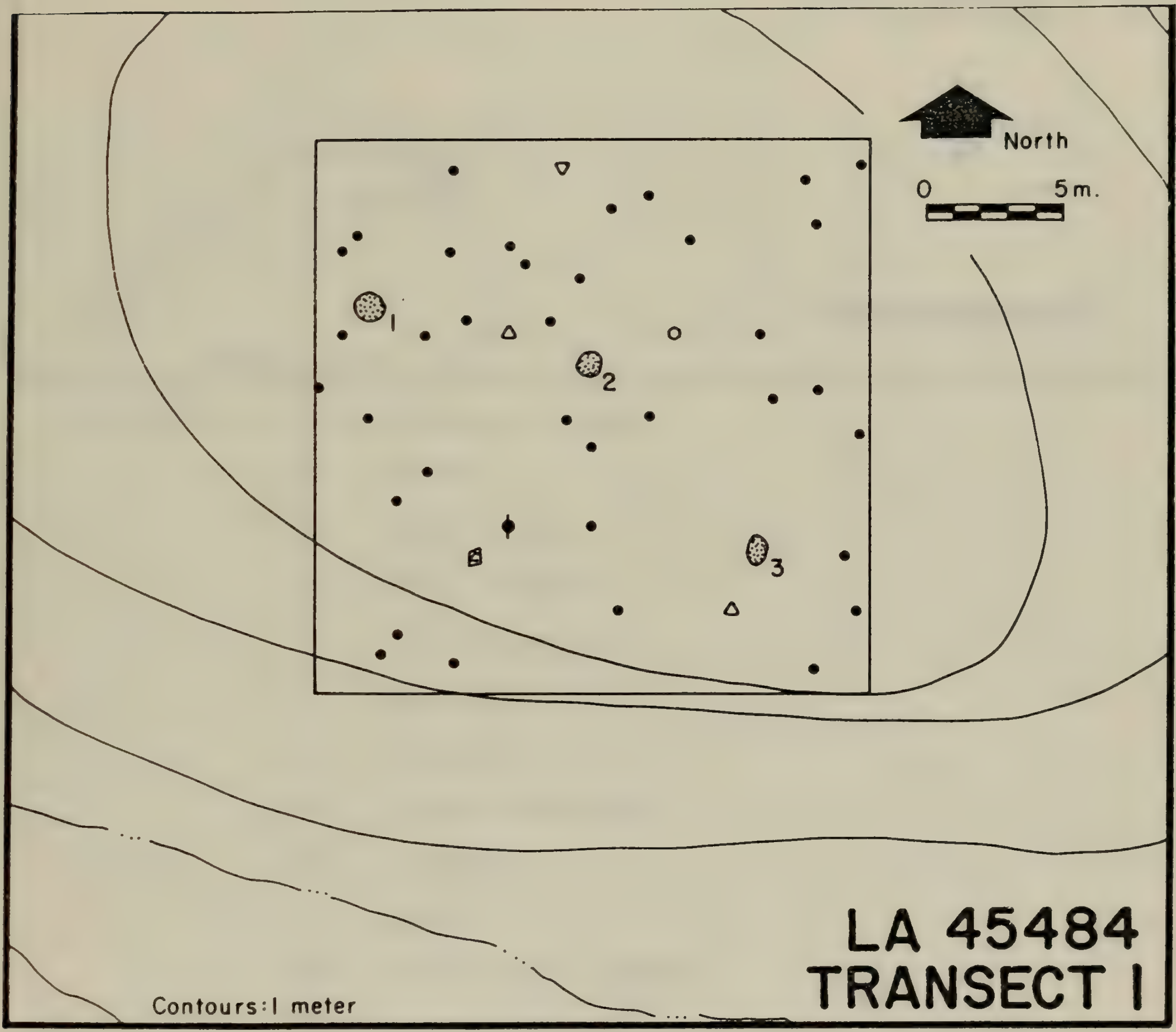
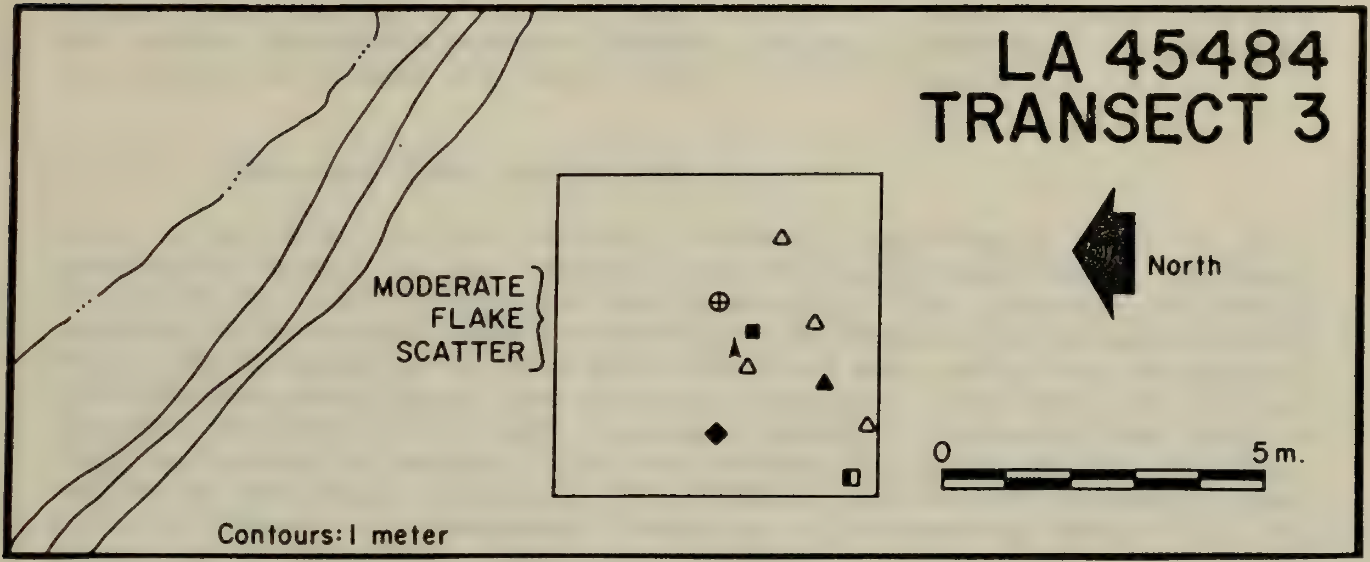


Figure 3.21
LA 45484 Sample Transect #3

This is a moderately dense lithic scatter within the site area. Several brownware sherds were noted just outside of the sample transect. If it were isolated this locale would be identified as a Type 2F temporary camp.



Artifact Key for LA 45484 Sample Transects:

•	flake
⧫	utilized flake
△	flake "scraper"
▲	projectile point
○	handstone
◆	millingstone
■	angular hammerstone
⊕	microcore
▲	biface
◧	cobble biface "chopper"
▽	cobble uniface "scraper/plane"
▨	sherd
◍	hearth

In summary, these large multiple use sites appear to represent favored locales which provide access to a diversity of resources (water, lithic, floral and faunal) and which received differential use for differing activities through time and perhaps seasonally. They are considered palimpsest sites which are representative of varying degrees of occupational complexity. The general scatter of cultural debris throughout these sites distinguishes them from other areas where there are a number of sites in relatively close proximity (e.g. Sample Units 7-25-29-5, 8-24-11-1 and 9-25-18-6). Some of these clustered site locales apparently represent similar phenomena collectively equivalent to the multiple use locales (see Sample Unit 7-26-18-4, Figures 2.2 - 2.4).

3.3.3.2 Temporary Camp Locales: Site Type 2

This is the most diverse and most commonly represented class of sites encountered during the Abo survey. The 70 sites in this category represent 53.85% of the total prehistoric site inventory. The presence of milling equipment (handstones, milling stones), hearth features, or ceramics coupled with a mixed assemblage of flake stone tools and flake debris are the primary characteristics identifying this site type category. The size and internal diversity of these sites is quite variable, forming a continuum from small to large and simple to complex. They are divided into eight subtypes based on assemblage and feature content. The various subtypes are discussed below and are ordered by decreasing frequency of occurrence within the site assemblage as outlined in Table 3.9. Tables 3.11 through 3.17 identify the Type 2 sites by subtype.

The most commonly occurring Type 2 subtype (16.15% of the prehistoric sites) are sites characterized by hearth features and a mixed flaked stone assemblage, and lacking milling equipment and ceramics (Type 2D). This is a highly diversified site type (Table 3.11) with a broad range in size (128 to 26,696 square meters), number of hearth features (1 to 12), number of artifacts (7 to 10,317), tool to flake ratio (1.23 to 605.88) and tool type diversity index (1.0 to 11.42). This diversity is presumably related to a variety of factors including functional variability (e.g., task specific locales versus temporary camps), number and duration of occupations or use events, sampling bias (for the larger sites only) and differential exposure.

Figures 3.22 and 3.23 illustrate two of the small Type 2D sites. These presumably represent single event encampments or special use (i.e., roasting) locales. LA 44872 (Figure 3.22) is a possible example of a potentially buried campsite just beginning to be exposed through erosion. Conversely, it may represent a task specific activity locus where a single roasting event occurred. This site is also considered a threshold example between a cultural resource designated as an isolated occurrence and one designated as a site. LA 44872 was assigned site status due to its potentially buried condition.

LA 44865 (Figure 3.23) is an example of a slightly more complex site. The size and internal diversity of this site are considered indicative of a short term, single use temporary camp where roasting activities were performed. The open area around the hearth feature, the scatter of artifacts ringing the hearth, and the relationship of the hearth to the main concentration of

cultural litter (Figure 3.23) is consistent with the distribution of cultural debris resulting from ethnographically observed roasting activities (Binford 1983:169-172). For example, Binford (1983:170) notes that "even on sites where only a minimal stay is anticipated, Australian Aborigines nevertheless construct their roasting pits in positions peripheral to the focus of camp life - areas used for sleeping, conversation, and small-scale food preparation and craft activities". LA 44865 appears to have resulted from analogous behavior.

Table 3.11
Site Type 2D Diversity Variables
(N = 21)

Site No. LA-	Size (m^2)	No. of Tools	Artifacts Flakes	No. of Hearths	Tool/ Flake Ratio(2)	Tool Diversity Index (3)
44850	1,800	11	48	+ (1)	4.36	1.22
44851	1,344	16	25	1	1.56	1.45
44852	13,284	23	145	10	6.30	1.64
44853	4,000	8	16	1+	2.00	1.60
44854	128	5	7	3	1.40	1.25
44865	2,112	13	16	1	1.23	1.00
44871	2,000	11	65	2	5.90	1.22
44872	1,378	1	6	+	6.00	1.00
44894	3,250	0	51	1	51.00	0.00
44897	4,340	17	22	1	1.29	1.41
44899	1,400	14	26	+	1.85	1.40
44913	2,400	3	32	1	10.66	1.00
44890	2,100	13	17	+	1.30	1.44
45469	8,100	80	1,000	12	12.50	11.42
45444	9,600	32	67	8	2.09	2.28
45455	24,000	17	10,300	1	605.88	2.42
45467	6,440	16	600	8+	37.50	1.77
45468	11,880	110	2,550	2+	23.18	4.58
45483	3,456	14	45	+	3.21	1.27
35474*	26,696	7	104	+	14.85	?

* Previously recorded
(1) + indicates presence of fire-cracked rock
(2) Number of tools divided into number of flakes: the lower the number the greater the ratio of tools
(3) Number of tool forms divided into total number of tools: the greater the diversity the closer to 1.0 (may be skewed by sampling)

Figure 3.22
LA 44872, A Small, Sparse Hearth (fire-cracked rock) and Chipped Stone Tool Assemblage Site, Type 2D.

This site represents an example of one extreme of this site type. It may have functioned as a single event, task specific activity area or may represent a larger site beginning to be exposed by deflation.

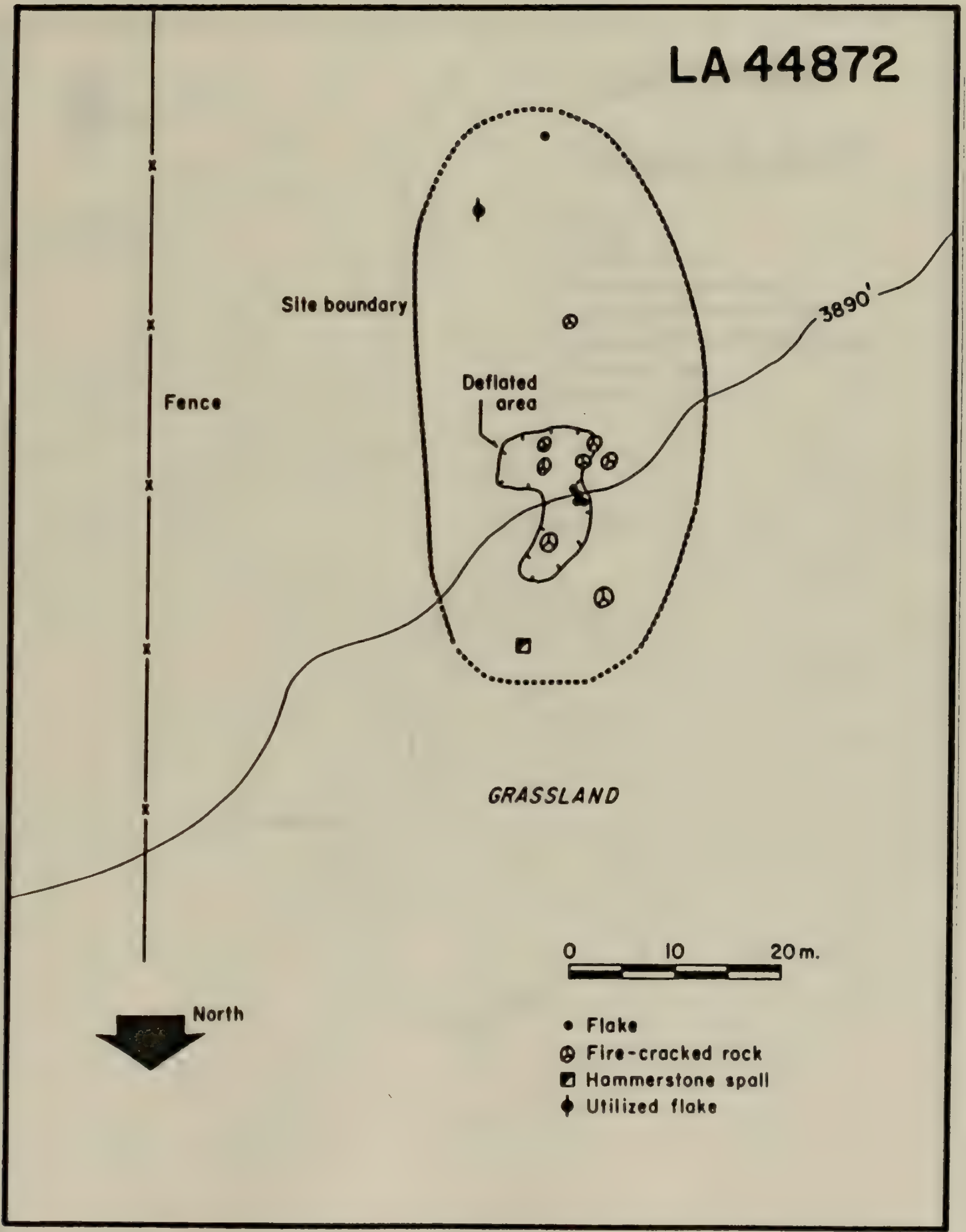


Figure 3.23
LA 44865, A Small Type 2D Site

Characterized by a single hearth feature and a light, chipped stone tool and flake scatter. The size and internal diversity represented by this site is considered indicative of a short-term temporary camp where roasting activities were performed. Note the open area surrounding the hearth feature and its relationship to the lithic debris.

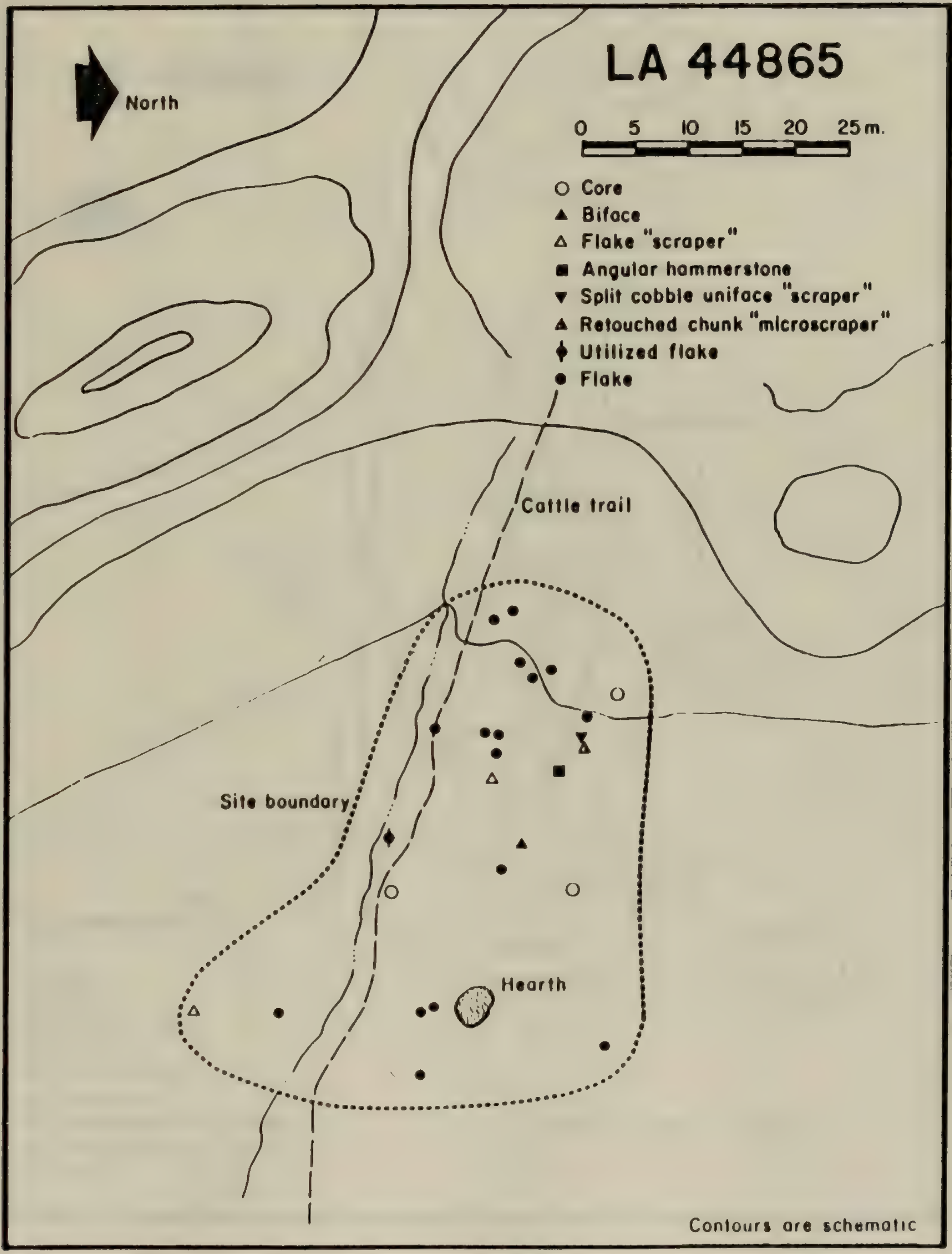


Figure 3.24
LA 44861, A Relatively Large and Diversified Type 2D Site.

Characterized by multiple hearth features (fire-cracked rock scatters), a diversified chipped stone tool assemblage and a cluster of satellite activity loci. This is presumably a locale that experienced reuse through time. The lack of milling equipment and ceramics coupled with a possible Paleoindian or Early Archaic projectile point may indicate an early occupation for the site.

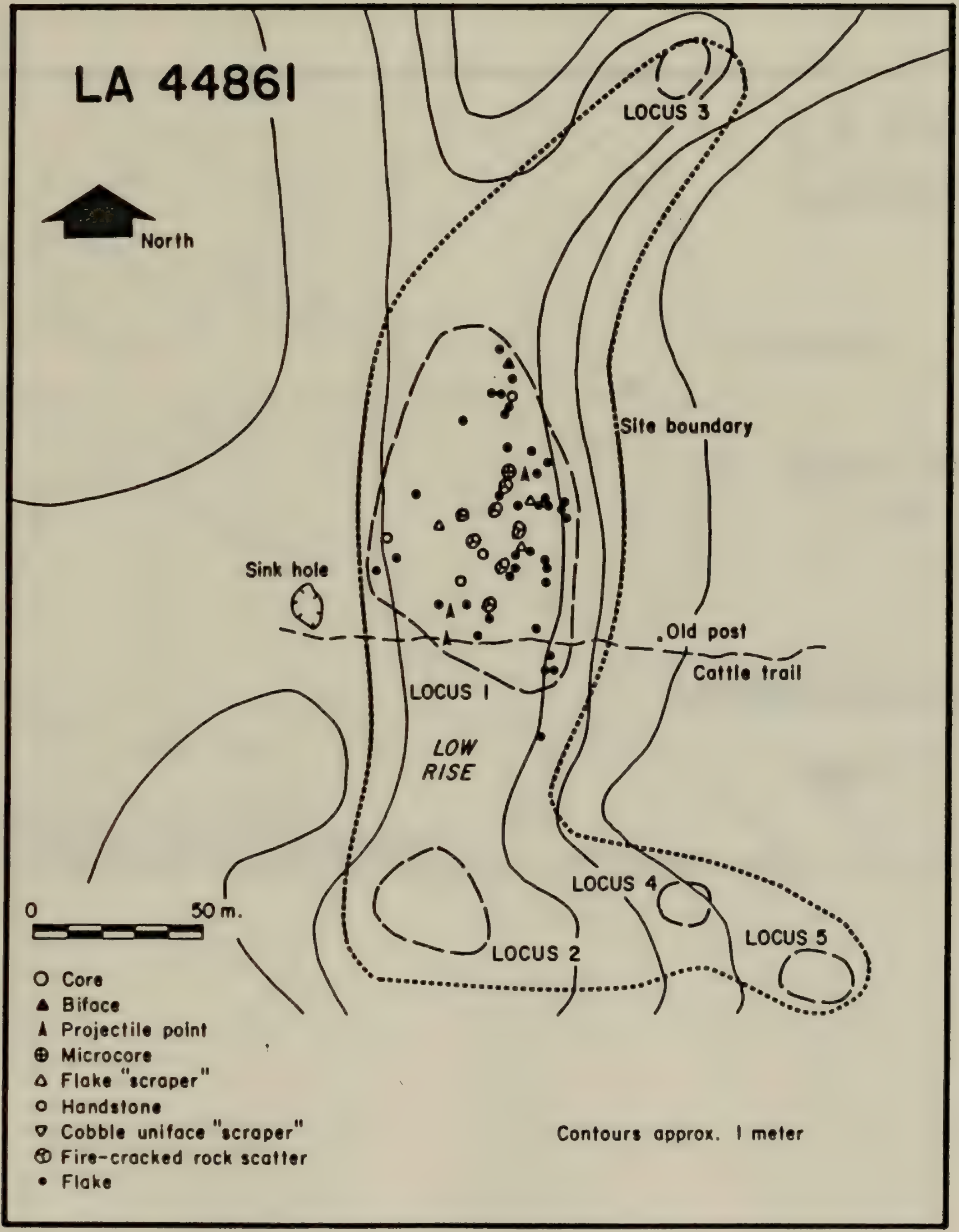
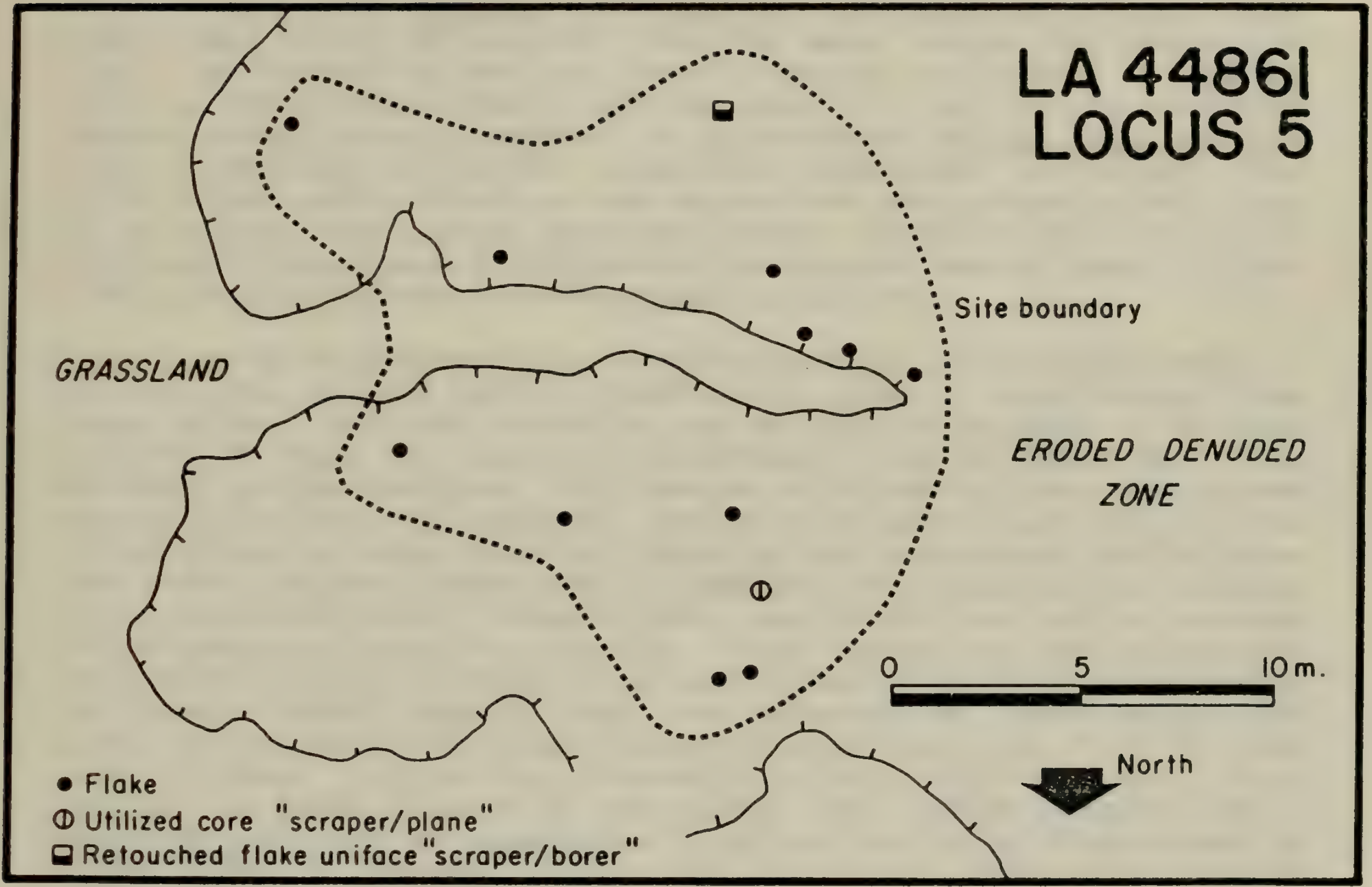


Figure 3.25
LA 44861 Locus 5

One of the small satellite limited activity loci associated with the larger, more dense site area. Note the erosional setting.



LA 44861 (Figure 3.24) represents a relatively large and diversified Type 2D site. It is characterized by multiple hearth features (fire-cracked rock scatters), and a diversified chipped stone tool assemblage. The number and distribution of the features and artifacts are considered indicative of a locale that experienced reuse through time (palimpsest). Roasting activities, as indicated by the fire-cracked rock scatters, appear to have been an important aspect of the site's occupations. In addition to the primary hearth locus of this site, there are four small, spatially isolated limited activity loci in the immediate vicinity. The ultimate relationship of these "satellite" activity loci to the hearth locus is uncertain. They may represent use of the area at different times for differing purposes not related to the hearth area occupation(s). Conversely, they may represent the location of contemporaneous spatially segregated activities performed by the occupants of the hearth locus. This site is differentiated from the large multiple use locales (site Type 1) on the basis of site size, and the diversity and number of artifacts. Also, the small limited activity loci associated with this site are considered elements which could be expected to be associated with a temporary camp locale, particularly one which experienced reoccurring use through time. There is also a strong likelihood that much of this site remains buried. Many of the artifacts are exposed along the eroding southern slope of the hearth locus and the occurrence of artifacts in the denuded zone of Locus 5 (Figure 3.25) appears to indicate a buried deposit in that area.

While these three examples do not exhaust the range of variability evident in this site type, they do serve to illustrate the degree to which some of these locales differ. Additional variability can be observed in some of the other attributes of these sites including the different types of chipped stone tools and their relative abundance. For example, while most of these sites include various large and small scraping, planing or chopping tools only 10 sites contain bifaces or biface reduction flakes in their assemblages; five of these also contain projectile points and an additional five sites contain projectile points and not bifaces. Projectile points and bifaces tend to be associated with hunting and butchering activities. Their presence at some of the sites and absence at others presumably reflects differences in the types of resources (faunal, floral) exploited from, and processed at, these locales. The second most commonly occurring temporary camp locales are Type 2C sites which represent 12.31% of the prehistoric site total. This site type is characterized by hearth features or fire-cracked rock, milling equipment and a mixed chipped stone tool assemblage. This site type is also characterized by a high degree of diversity (Table 3.12). There is a considerable range in site size (1,122 to 40,950 square meters), number of artifacts (28 to 1,780), flake to tool ratios (1.55 to 21.5), tool diversity index (1.38 to 17.3) and types of chipped stone tools present. This diversity presumably results from differential intensity of use (i.e., duration, size of social unit and number of occupational events), functional variability (e.g., seasonality or differences in resources exploited and processed), differential exposure, and (for the larger sites) sampling bias.

These sites are distinguished from the Type 2D sites by the presence of milling equipment. They were presumably locales where seed resources (undomesticated or possibly domesticated) were processed and where other processing activities, including roasting or cooking, were conducted. The co-occurrence of milling equipment and hearth features is considered a strong indicator of temporary camp function for these sites.

Table 3.12
Site Type 2C Diversity Variables
(N = 16)

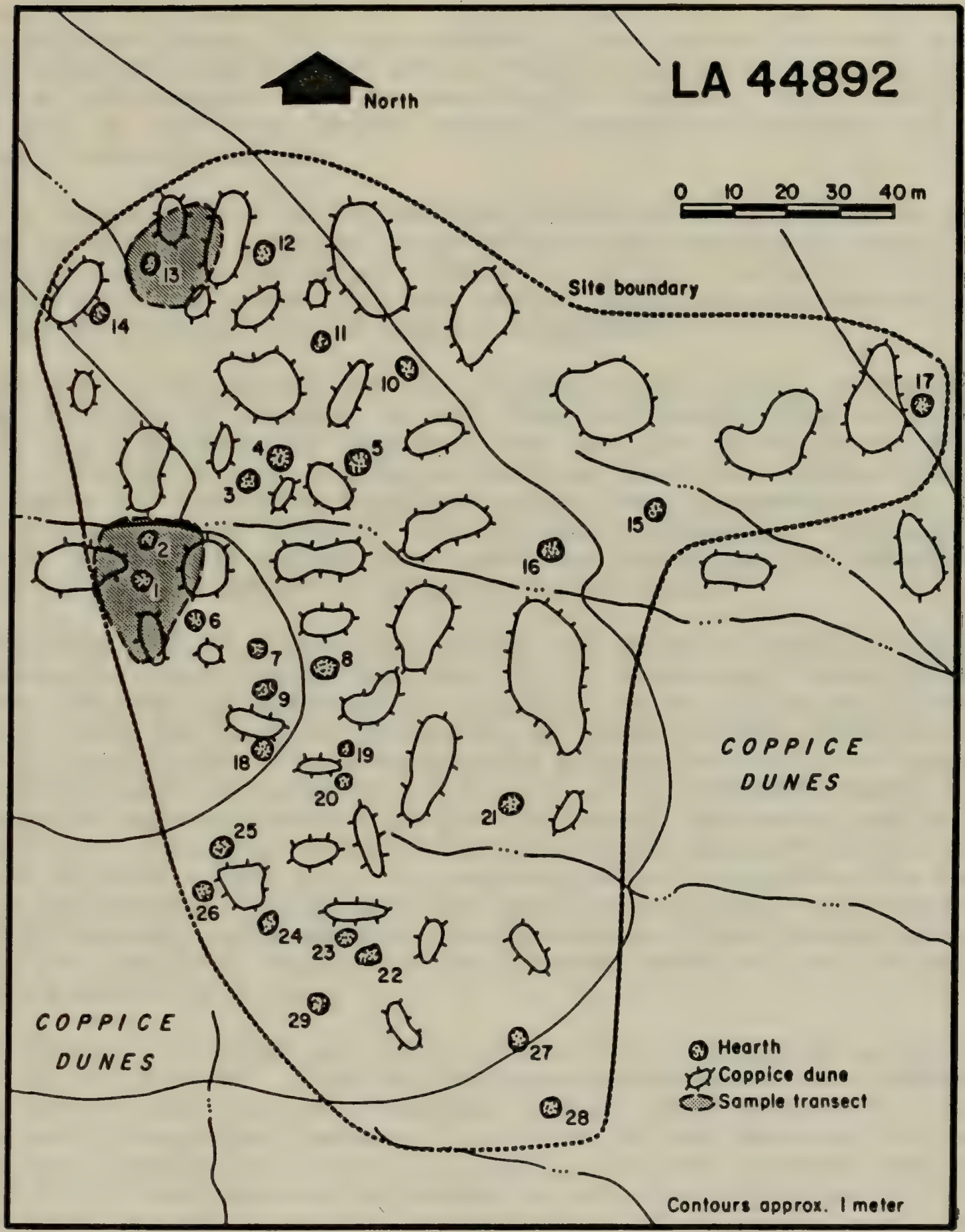
Site No. LA-	Site (m^2)	No. of Tools	Artifacts Flakes	No. of Hearths	Tool/ Flake Ratio (2)	Tool Diversity Index (3)
44855	5,700	13	15	+	1.55	1.62
44861	6,300	22	76	7	3.45	1.57
44895	12,750	24	215	11	8.95	1.84
44896	37,800	22	473	10	21.50	1.69
44906	25,300	49	111	1	2.26	2.33
44911	1,400	11	49	2	4.45	1.83
44879	3,000	16	36	+ (1)	2.25	1.45
44889	19,750	40	112	4+	2.80	2.22
44892	32,736	170	1,575	29+	9.26	8.94
45461	40,950	86	450	12+	5.23	17.30
45474	19,380	25	187	11	7.19	1.38
45458	6,000	200	1,580	25+	7.90	16.66
45481	4,032	10	40	+	4.00	1.42
45496	21,000	18	126	+	6.30	2.25
45445	10,584	10	18	9+	1.80	1.42
20203*	1,122	6	?	2	?	2.00

* Previously recorded
(1) + indicates presence of fire-cracked rock
(2) Number of tools divided into number of flakes; the lower the number the greater the ratio of tools
(3) Number of tool forms divided into total number of tools; the greater the diversity the closer to 1.0 (may be skewed by sampling)

As previously noted, these sites vary in size and complexity ranging from small and relatively uncomplicated to extensive and complex. LA 44892 (Figure 3.26) is representative of the latter sites. This large hearth and lithic scatter site is located on a dune-capped terrace (Blackdom) overlooking the Pecos River floodplain and bordering the mouth of a large unnamed drainage which enters the Pecos River from the west. More than 29 individual fire-cracked rock hearth features are present at this site and a general scatter of lithic debris occurs throughout, interrupted periodically by coppice dunes. This site is considered representative of a large, multiple occupation palimpsest site utilized primarily as a temporary camp and roasting activity locale. It was presumably a favored area which saw repeated use through time. The lack of ceramics and presence of late Archaic projectile points indicates that the major period of use at this locale was during the late preceramic horizon. A somewhat similar site, LA 2707, is relatively close. This is a large sherd and lithic scatter with milling equipment and numerous fire-cracked rock hearth features (Type 2A site) located on a low gravel knoll above the Pecos River floodplain (Fenenga and Cummings 1956:217). The ceramics, a small late ceramic period arrow point and a late Archaic projectile point (Fenenga and Cummings 1956:218) indicate that LA 2707 may have

Figure 3.26
LA 44892, A Large Aceramic Multiple Hearth Temporary Camp Locale, Site Type 2C

Note the spatial distribution of the hearth features and the site's location in a coppice dune field.



replaced LA 44892 as the focal point of occupation during the ceramic period. The late Archaic point at LA 2707 (Fenenga and Cummings 1956:Figure 148g) indicates the two sites may have been contemporaneous locales used during the terminal Archaic period.

Figures 3.27 and 3.28 illustrate two of the hearth areas at LA 44892. Note the variability in assemblage size between these two areas. The hearth feature #13 area (Figure 3.27) is considered a good example of a task specific locus or temporary camp oriented around roasting activities. The very sparse assemblage may indicate a single use event. However, the coppice dune setting may be concealing buried cultural deposits representative of more intensive or extended activity.

The area represented by hearth features #1 and #2 (Figure 3.28) is considered an example of a palimpsest or multiple-use roasting activity area. That is, although the tool assemblage content is somewhat different, this area appears to represent a locale that was used in much the same fashion as the hearth feature #13 area, only on repeated occasions.

Although some of the hearth areas in LA 44892 contain milling equipment and meet the site Type 2C criteria, the two illustrated locales (Figures 3.27 and 3.28) do not include milling equipment and are more characteristic of site Type 2D. The distribution of cultural debris at the hearth feature #1 and #2 locale (Figure 3.27) contrasts significantly from that represented at LA 44865 (Figure 3.23), a small Type 2D site previously discussed. Although the assemblage diversity is similar, the spatial variability may be indicative of differing functions or behavioral modes for the two areas.

LA 44911 (Figure 3.29) represents a small, low diversity Type 2C site with two fire-cracked rock hearth features. It is provisionally identified as a temporary campsite characterized by an emphasis on milling and roasting activities. Note the variable distribution of cultural debris relative to the features (Figure 3.29). The occurrence of cultural debris in the immediate vicinity of the hearth features as well as spatially segregated is similar to the distribution of cultural debris at the LA 44892 hearth features #1 and #2 area (Figure 3.28). This may indicate congruence in the behavior modes of the occupants of the two sites (e.g., a functional similarity requiring the use of flakes or resharpening of flake tools for some purpose directly associated with the hearth feature). Alternatively, the occurrence of flake debris and stone tools in the immediate vicinity of the hearths could be the product of overlapping use or occupancy.

Another relatively commonly occurring manifestation of temporary campsites is represented by Type 2A. This site type is characterized by the addition of ceramics to a typical Type 2C assemblage. These sites are generally one of the most easily recognized temporary camp (class 2) site types and represent 7.69% of the prehistoric site total. As a group they are relatively diversified (Table 3.13). This diversity is evident in the size differences (1,312 to 242,900 square meters), number of stone artifacts (31 to greater than 1,197), number of sherds (3 to 184), occurrence of hearth features (1 to 16+), tool to flake ratios (.61 to 15.80), tool diversity index (1.25 to 5.83), and site structure. The diversity is presumably related to a variety of factors including differential intensity of use, functional variability, differential exposure and sampling bias.

Figure 3.27
LA 44892, Hearth Feature #13 and Adjacent Cultural Debris.

Note the setting in between the sand dunes. This is tentatively considered an example of a short-term or single event task specific roasting locus. By itself it would represent a Type 2D site.

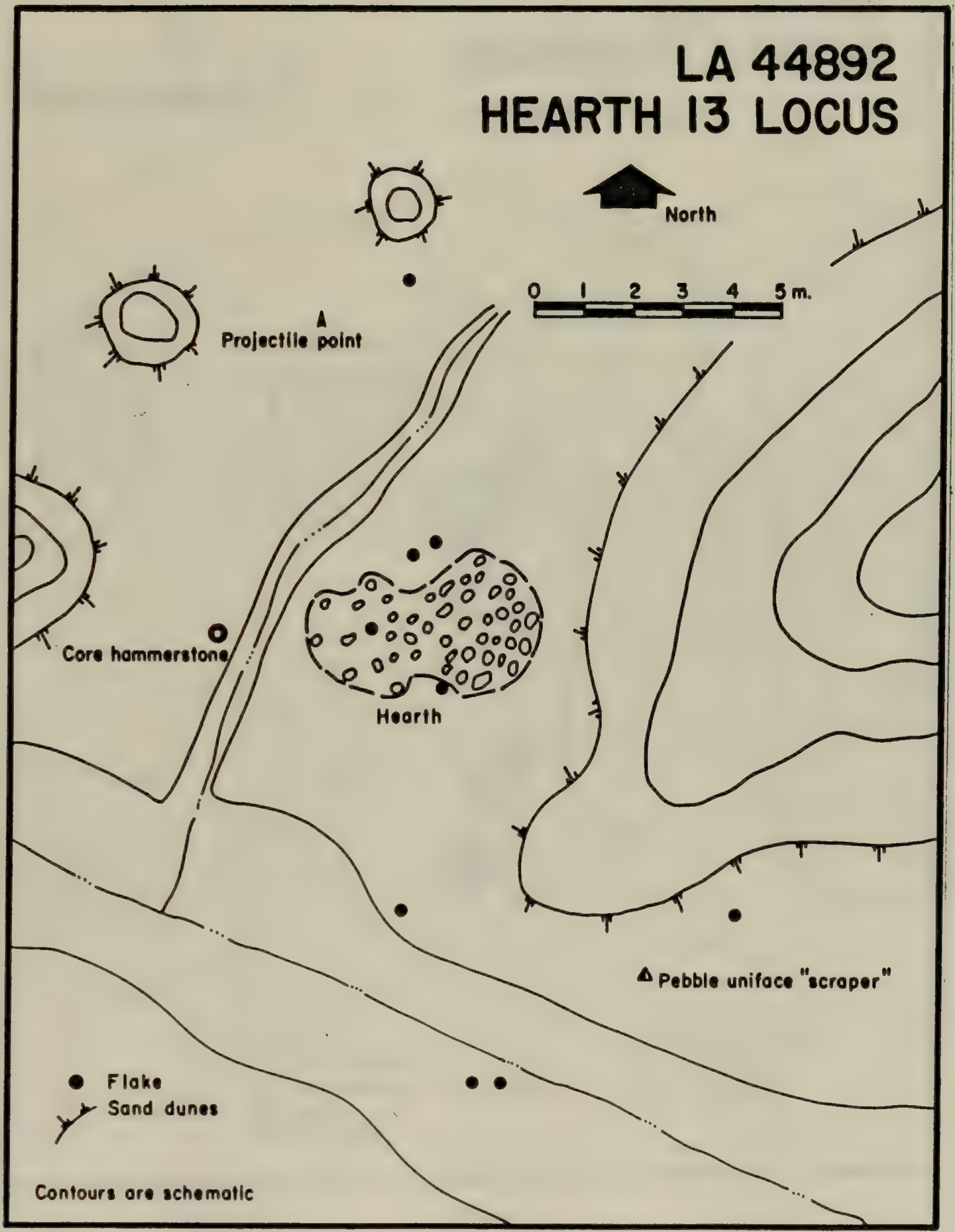


Figure 3.28
LA 44892, Hearth Features 1 and 2 and Surrounding Cultural Debris.

Note the setting between the coppice sand dunes. This is considered an example of a roasting activity area that received repeated use. By itself this locale would represent a Type 2D site.

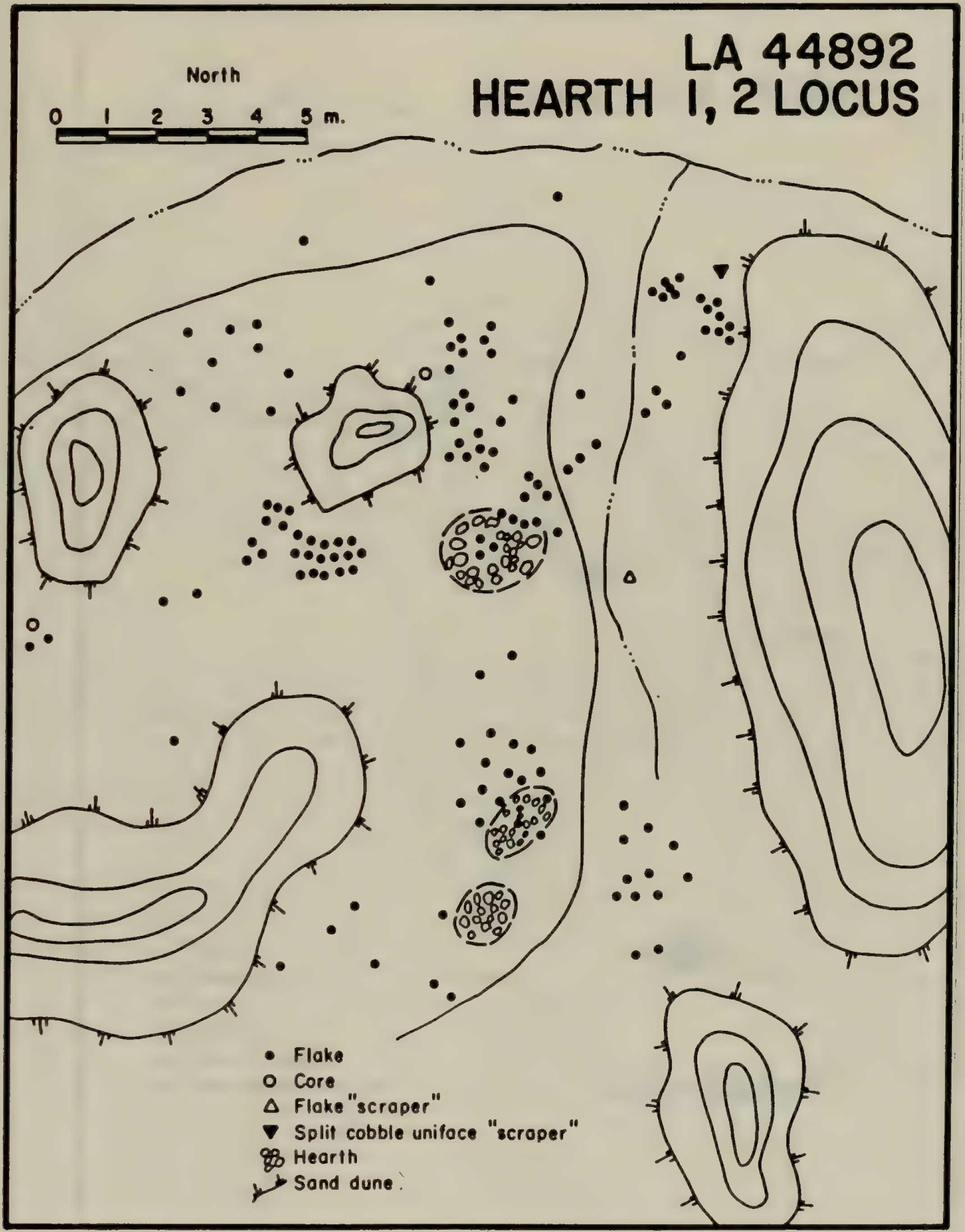


Figure 3.29
LA 44911, A Type 2C Site

This is an example of a relatively small temporary campsite characterized by two hearth features, milling equipment and a mixed flaked stone tool assemblage.

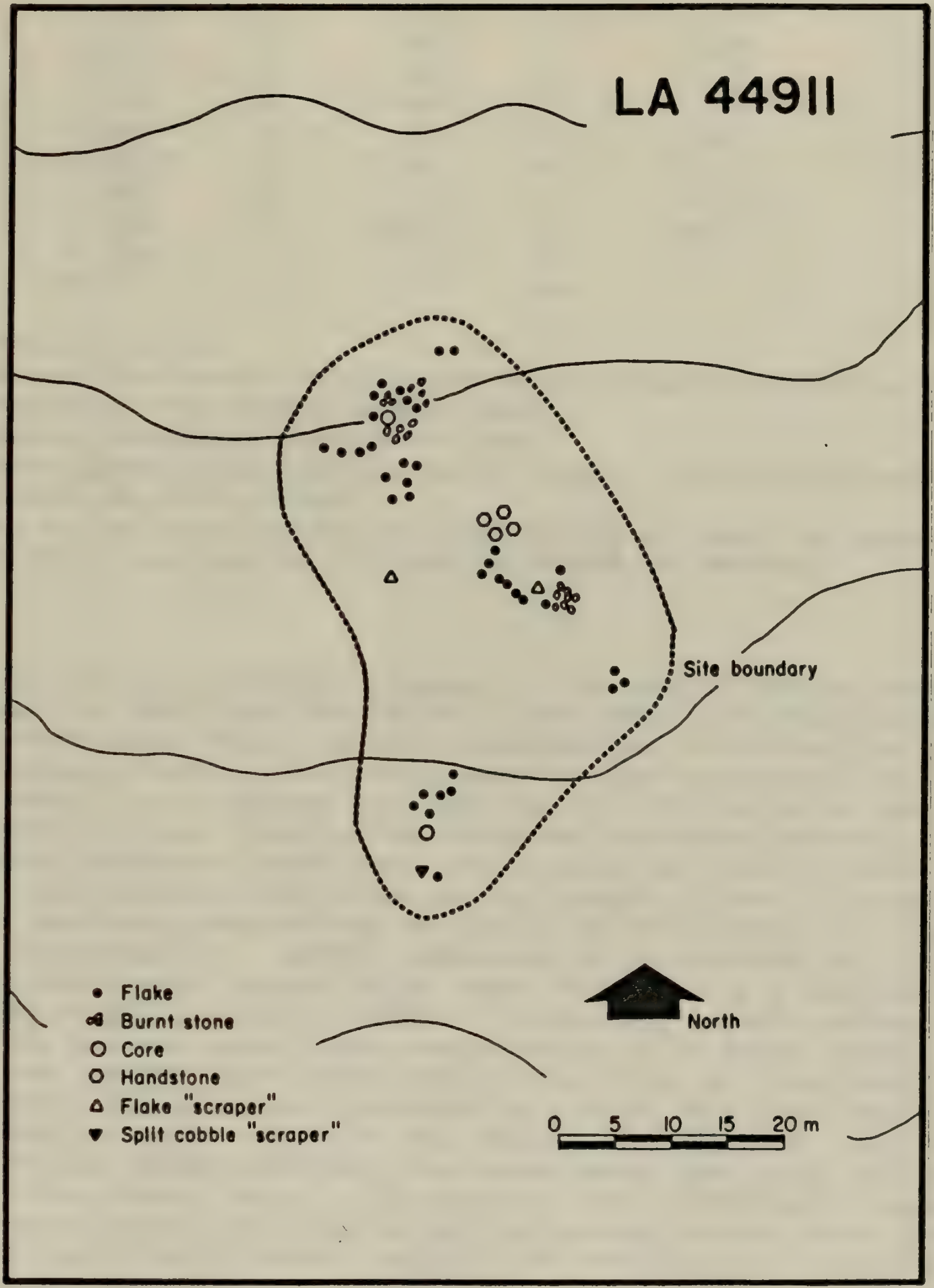


Table 3.13
Site Type 2A Diversity Variables
(N = 10)

		No. of Lithic Artifacts			Tool/	Tool
Site No.	Size (m^2)	Tools	Flakes	No. of Hearths	Flake (2) Ratio	Diversity (3) Index
44858	5,600	19	104	+ (1)	5.47	1.46
44859	1,312	17	56	+	3.29	1.70
44883	1,750	58	123	1	2.12	2.23
44908	11,250	26	224	2	8.61	2.00
44909	6,650	5	79	2	15.80	1.25
44874	79,200**	74	1,123	2+	15.17	2.46
44888	1,800	13	8	1	0.61	1.44
45464	9,450	70	1,048	6	14.97	5.83
34372*	15,625	?	?	2+	?	?
37852*	242,900	?	?	16+	?	?

* Previously recorded

** The area of the ceramic locus at this site is indicated; the entire site encompasses at least 97,200 square meters

(1) + indicates presence of fire-cracked rock

(2) Number of tools divided into number of flakes: the lower the number the greater the ratio of tools

(3) Number of tool forms divided into total number of tools: the greater the diversity the closer to 1.0 (may be skewed by sampling)

Figures 3.30 and 3.31 illustrate examples of two small Type 2A temporary camp locales (LA 44883 and LA 44859). Both sites are characterized by relatively limited areal extent, discrete concentrations of cultural debris and similar assemblage content. Both are located in close proximity to the Pecos River; LA 44883 is in a coppice dune field and LA 44859 is on an open, flat sand and gravel terrace. Both of these sites are considered representative of small temporary habitation locales that were occupied by relatively small social units (e.g., one extended family) for varying periods of time. The variability in their assemblage content may be due to differing length of occupation or amount of reoccupation. Another difference is the presence of a discrete fire-cracked rock hearth feature at LA 44883 contrasted to a generally light scatter of fire-cracked rock at LA 44859. The spatially isolated setting of the hearth feature and the smaller lithic concentration at LA 44883 (Figure 3.30) away from the primary sherd and lithic concentration are considered to be very distinctive site structure correlates to specific behavioral modes. As Binford (1983:170) notes, "activities like roasting and butchery, which monopolize considerable amount of space, are located away from areas used intensively on a day-to-day basis". For example, the Tarahumara Indians of northern Mexico employ large roasting pits for cooking desert plants (notably Agave) which are usually located behind their dwellings yet away from the doorside activity areas (Binford 1983:170,171; Pennington 1963:129,131, Plate XVII). Although no evidence of a dwelling (e.g., pithouse) was noted at LA 44883, the feature and artifact distribution at the site indicates a similar practice.

Figure 3.30
Site LA 44883, A Relatively Small Type 2A Temporary Camp Locale.

Note the relationship of the hearth feature and isolated lithic concentration to the primary concentration. Not all of the stone tools outside of the major concentrations are indicated. There are a number of diverse tools scattered about the site area and clustered within the larger concentration.

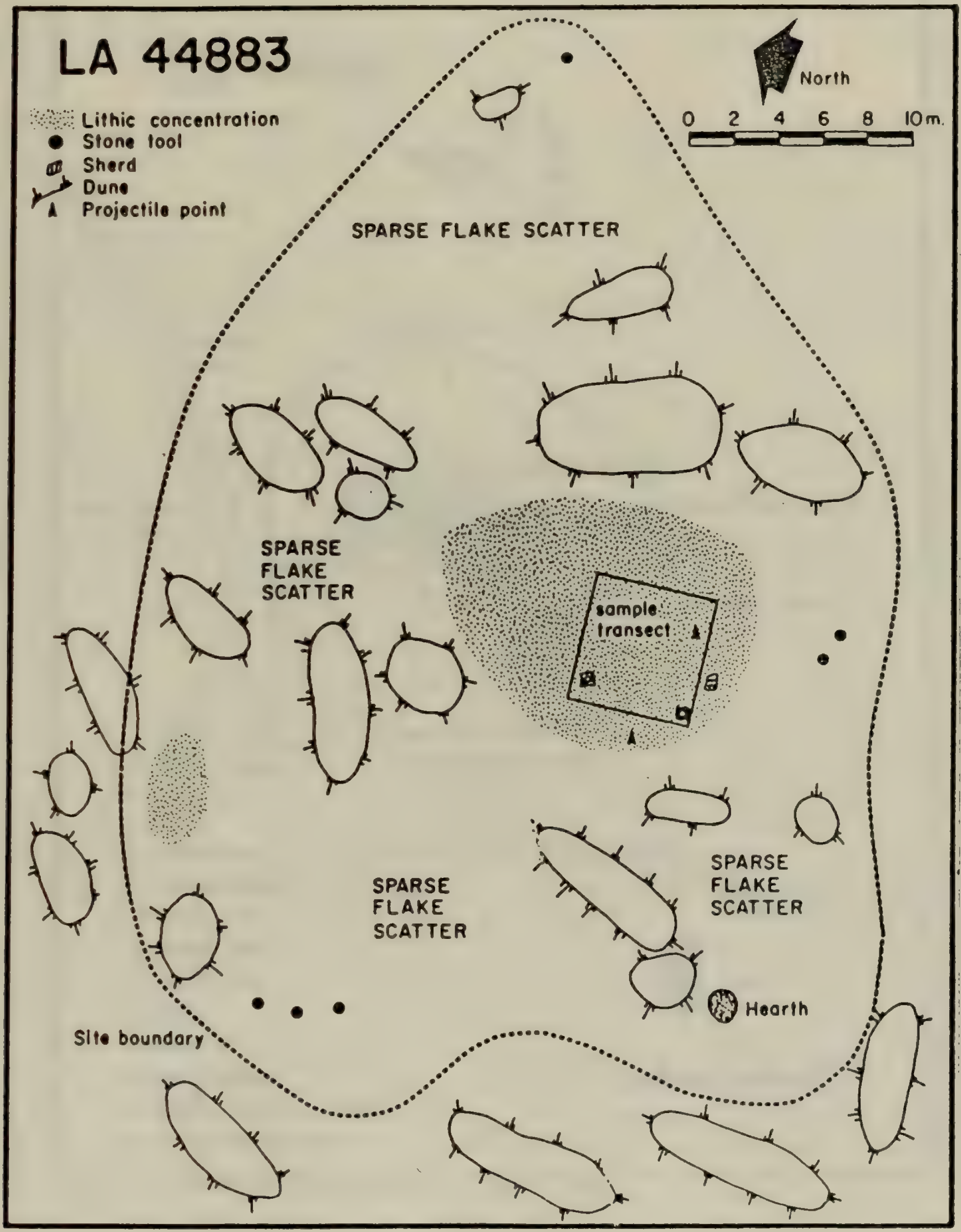
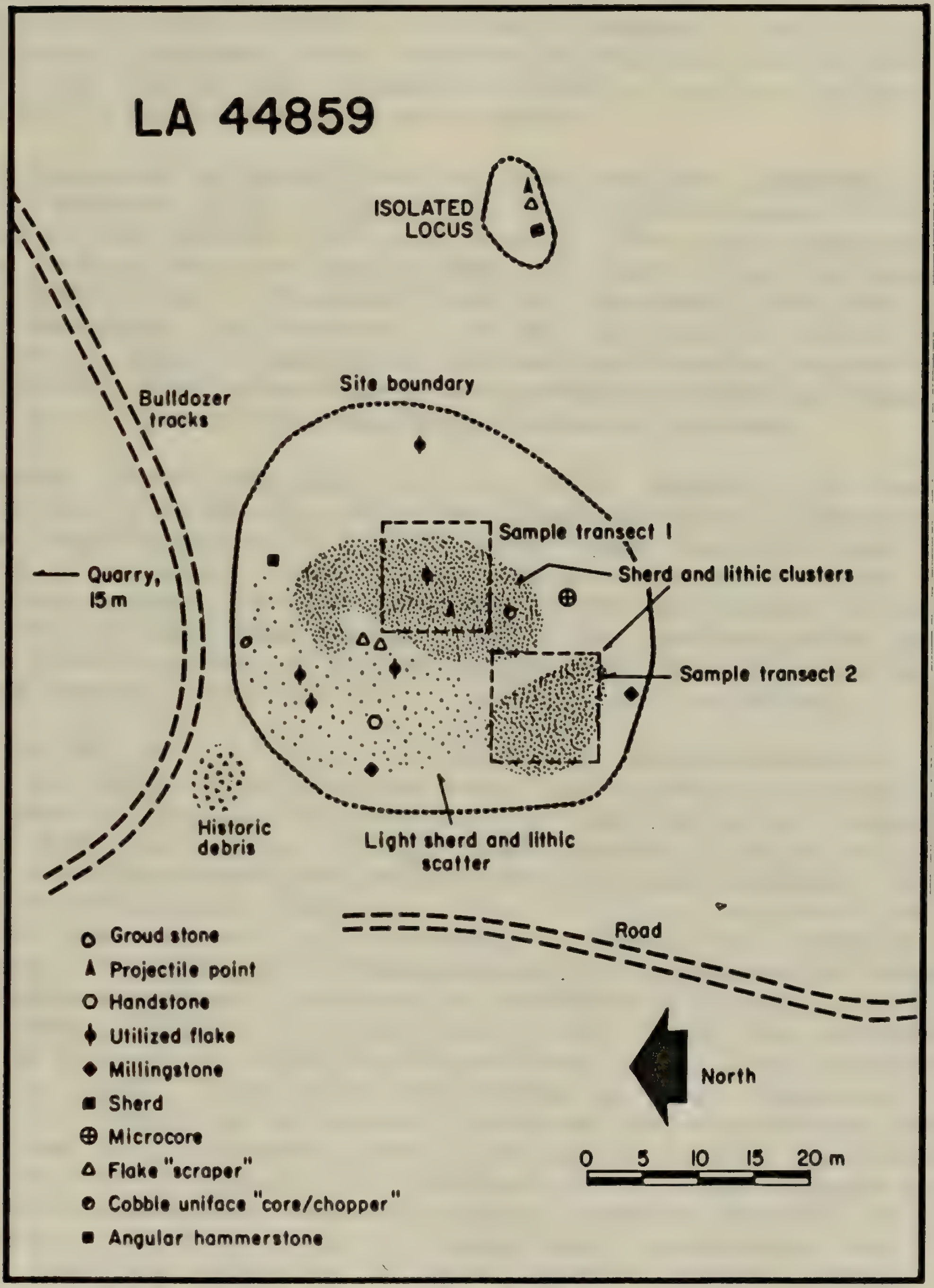


Figure 3.31
LA 44859, a Small Type 2A Temporary Camp Locale

Note the two sherd and lithic clusters with light, general scatter. A light scatter of fire-cracked rock is present at this site.



[illegible]

[illegible]

Another manifestation of the Type 2A site class is illustrated in Figure 3.32. This site (LA 44908) is a relatively large sherd and lithic scatter containing milling equipment and several fire-cracked rock or ash stain hearth features. This site may represent a locale contemporaneously occupied by multiple social units, or possibly a palimpsest site reoccupied through time, or both. The presence of projectile points and burned bone at this site indicates a subsistence emphasis on hunting as well as the plant resources indicated by the milling equipment. Whether the hearth features functioned as roasting pits for faunal resources, plant resources or both is presently undetermined. The ash stain feature may represent a specific function distinct from that represented by the fire-cracked rock hearths.

The site illustrated in Figure 3.33 (LA 44874) has been designated as a Type 2A site. However, it is a large area that was the scene of at least two occupations, one Archaic and one ceramic. The two components occupy different areas of the site (upper locus and lower locus) and appear to be spatially discontiguous. However, there is a generally light scatter of lithic artifacts throughout the site area. This site was given a Type 2 designation rather than a Type 1 designation because the diversity evidenced by the assemblage and distribution appears predominately related to temporary camp activities rather than a broad spectrum of diverse functions.

The ceramic period component at LA 44874 (Figure 3.33 lower locus) represents the Type 2A site, while the Archaic component (Figure 3.33 upper locus) is characteristic of a Type 2C site. Both components are viewed as the result of temporary camping. As indicated by the relative density of cultural litter between the two major loci (upper and lower), the intensity of use appears to have been greater during the Archaic period than later. Also, the relative paucity of milling equipment at this site indicates that seed processing played a relatively minor role in the site's activities.

Site Types 2E, 2F and 2G are identified as manifestations of temporary campsites or limited activity locales which lack evidence of hearth features. Each of these site types is characterized by flake debris and a mixed chipped stone tool assemblage. The Type 2E sites represent 5.38% of the prehistoric sites and are distinguished by the presence of milling equipment and absence of ceramics and hearth features. Type 2F sites comprise 4.61% of the prehistoric site total and include milling equipment and ceramics in their assemblages. Site Type 2G is distinguished by the presence of ceramics and lack of milling equipment. Considerable variability is evident in each of these site categories (Tables 3.14, 3.15 and 3.16). Most are relatively small although at least one in each group is relatively large. The variability among and within these three site type categories may represent temporal, functional, or behavioral differences. Erosional and depositional factors and sampling bias are presumably also contributing to this variability. The presence of milling equipment or ceramics with a mixed chipped stone tool assemblage is considered a relatively strong potential indicator of temporary camp locales. However, some of these sites, particularly the Type 2G examples, may be indicative of task specific limited activity locales. Similarly, some of the Type 4 sites may represent temporary camps.

Figure 3.32
LA 44908, A Moderately Large Type 2A Temporary Campsite.

Characterized by three hearth features, ceramics, milling equipment and a diversified chipped stone tool assemblage. There is a general flake scatter throughout the site area. The presence of projectile points and burned bone presumably indicates an emphasis on hunting, as well as the food processing indicated by the milling equipment and hearth features.

Artifact Key for LA 44908:

▴ projectile point
▲ biface
△ biface "Scraper"
○ core
o handstone
■ angular hammerstone
□ unmodified cobble hammerstone
◧ cobble biface "chopper"
▼ split cobble uniface "scraper/chopper"
△ flake "scraper"
◈ sherd
bone

Figure 3.32 (continued)
LA 44908, A Moderately Large Type 2A Temporary Campsite.

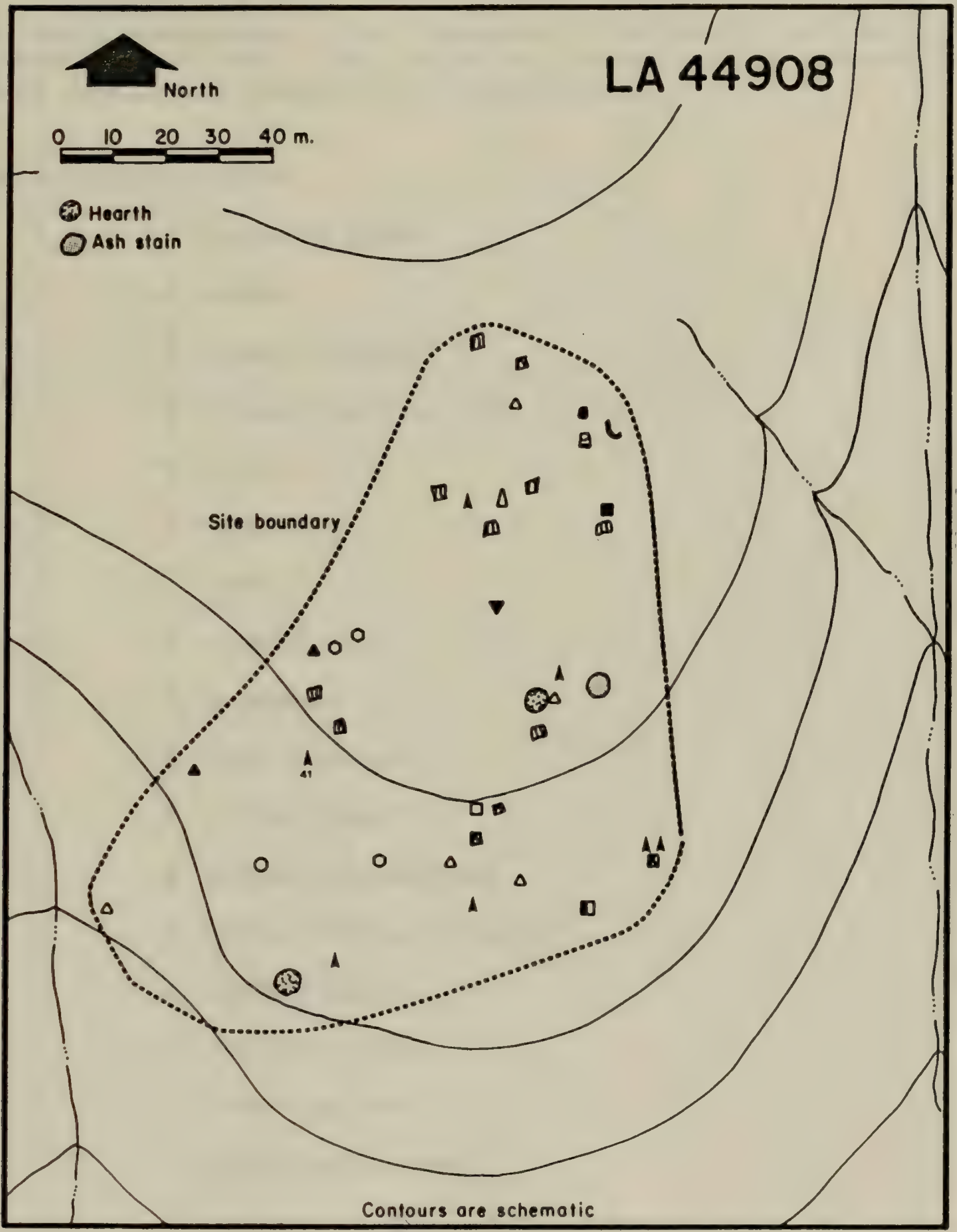


Figure 3.33

LA 44874, A Multicomponent Archaic and Ceramic Period Temporary Campsite.

The Archaic component (upper locus) is characterized by a scatter of flake debris, chipped stone tools, milling equipment and fire-cracked rock; and by itself is representative of a Type 2C site. The ceramic component (lower locus) is characterized by a scatter of flake debris, chipped stone tools, a sparse sherd assemblage, milling equipment, two hearth features and scattered fire-cracked rock. The degree of spatial overlap between the two identified depositional components is undetermined.

Artifact Key for LA 44874:

▲ projectile point

▴ biface

Δ biface "scraper"

▲ biface/projectile point

⊟ sherd

o handstone

○ core

⦶ utilized core

⊕ microcore

△ flake "scraper"

⧫ utilized flake

■ angular hammerstone

△ pebble uniface "scraper"

▽ utilized cobble

◘ retouched flake

◙ core/"scraper"

◙ microcore/"scraper"

∴ indicates relative artifact density

Figure 3.33 (continued)
LA 44874, A Multicomponent Archaic and Ceramic Period Temporary Campsite.

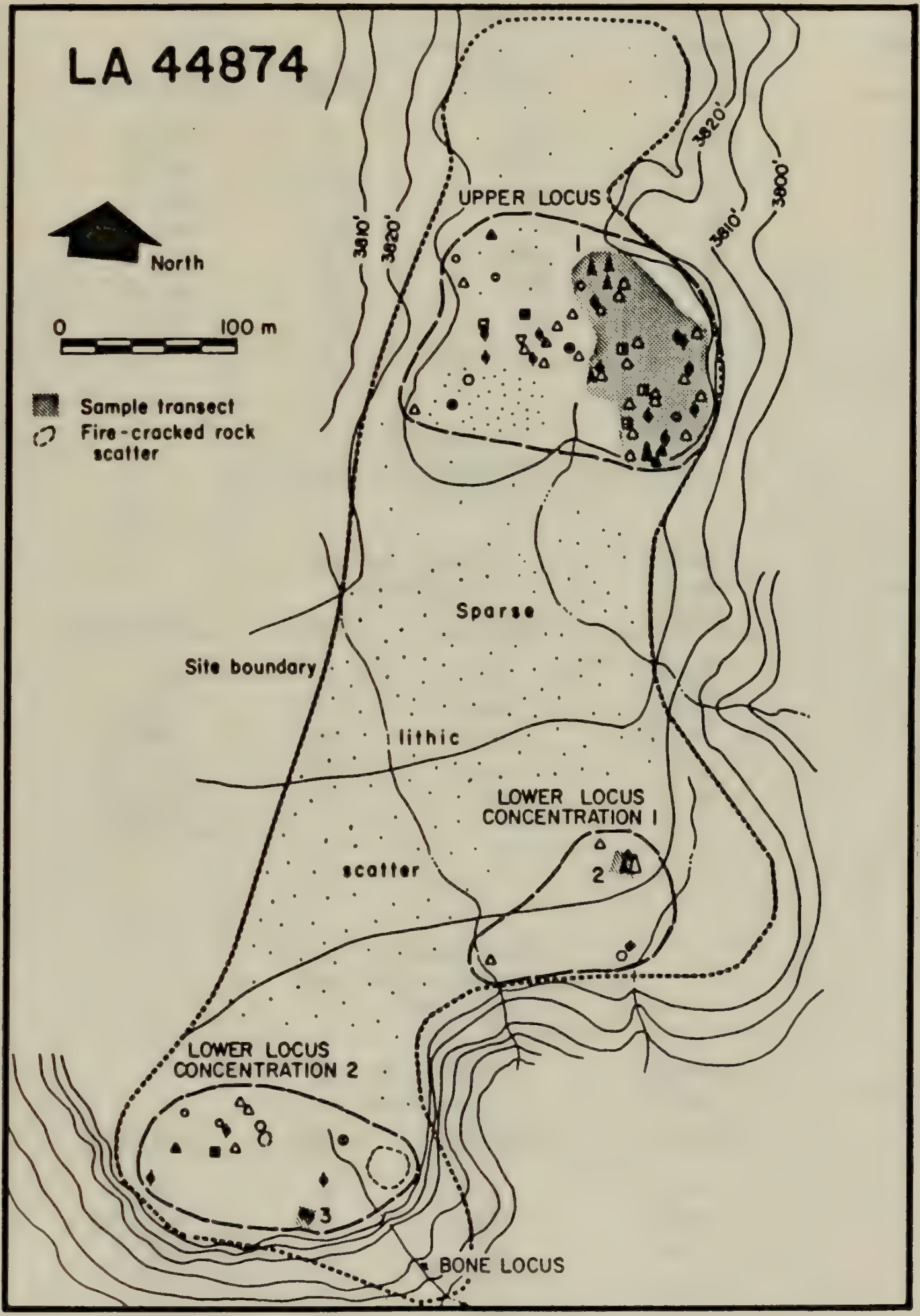


Table 3.14
Site Type 2E Diversity Variables
(N = 7)

Site No. LA-	Size (m^2)	No. of Lithic Artifacts Tools	Flakes	Flake/ Tool Ratio	Tool Diversity Index
44898	8,050	27	108	4.00	1.92
44900	5,076	16	12	0.75	1.60
44902	1,600	1	17	17.00	1.00
44907	4,500	5	8	1.60	1.00
45450	175,000	311	3,100	9.96	9.14
45479	45,900	63	158	2.50	3.00
45472	2,520	29	38	1.31	1.81

Table 3.15
Site Type 2F Diversity Variables
(N = 6)

Site No. LA-	Size (m^2)	No. of Lithic Artifacts Tools	Flakes	Flake/ Tool Ratio	Tool Diversity Index
44884	750	7	49	7.00	1.00
44886	1,575	14	263	18.78	1.27
44887	4,950	20	136	6.80	1.66
45447	19,250	60	264	4.40	6.00
45465	3,654	13	44	3.38	1.85
2710*	1,000-5,000				

Table 3.16
Site Type 2G Diversity
(N = 5)

Site No. LA-	Size (m^2)	No. of Lithic Artifacts Tools	Flakes	Flake/ Tool Ratio	Tool Diversity Index
44885	1,800	5	11	2.20	5.50
45446	281,250	18	196	10.88	1.20
45480	2,304	5	42	8.4	1.66
45448	598	11	64	5.81	1.37
45482	2,016	6	18	3.00	1.20

The lack of evidence of hearth features at these sites does not necessarily mean that fires for cooking or heating (hearths) were never there. Definition of hearth features during survey reconnaissance is most often based on concentrations or scatters of fire-cracked or burned rock and rarely solely on ash, charcoal or burned earth features. The rock hearth features presumably represent earth ovens or roasting pits (intact ovens, backfill from emptied pits, and scattered remnants; e.g., Pennington 1963:Plate XVII) , a specialized form of cooking facility. Many of the hearth features typically present at ethnographically documented temporary camps do not contain rock nor necessarily do earth ovens (Binford 1983:144-176). These hearth types presumably have relatively poor preservation potential (unless buried not long after use) and therefore would be difficult or impossible to detect during survey.

Figure 3.34 illustrates an example of a moderate sized Type 2E site (LA 44900) located in relatively close proximity to the Pecos River. The single handstone in the assemblage is only slightly worn indicating that milling activities were relatively limited at this site. Terrace gravels are available in the immediate vicinity and the assemblage indicates that these were exploited for a series of scraping and cutting tasks. The rather large and dispersed nature of the relatively small assemblage indicates that this site may be a palimpsest representing a series of limited activity or task specific events. However, the apparent spatial segregation of tools and flakes (note the roughly circular area encompassed by flakes on the southeast and tools on the north and west) could be indicative of a particular behavioral mode at a temporary camp.

It is probable that some of the larger sites in the site Type 2E, 2F and 2G categories were the scene of a series of overlapping camp and limited activity episodes. The relative occurrence of milling equipment and ceramics to other artifacts at some of these sites is quite low indicating that milling activities and ceramic use played relatively minor roles in the site's activities.

Site Type 2B is similar to the Type 2G sites. The distinguishing characteristic is the presence of fire-cracked rock features at the Type 2B sites. There are four examples of this site type in the Abo project inventory representing 3.07% of the prehistoric sites. As with the previously discussed site types this category is characterized by considerable diversity (Table 3.17).

Table 3.17
Site Type 2B Diversity Variables (N = 4)

Site Number	Size (m^2)	No. of Tools	No. of Flakes	No. of Hearths	Flake/ Tool Ratio	Tool Diversity Index
LA 44867	3,800	18	66	2+	3.66	1.63
LA 44880	4,810	6	16	+	2.66	1.50
LA 45459	12,075	520**	2200**	8+	**4.23	?
LA 2531*	?	29	?	+	?	?

* Previously recorded
** Based on 2.5% sample

Figure 3.34
LA 44900, A Type 2E Site

Located on the dissected terrace overlooking the Pecos River. Note the relatively dispersed assemblage and the differentially distributed tools and flakes.

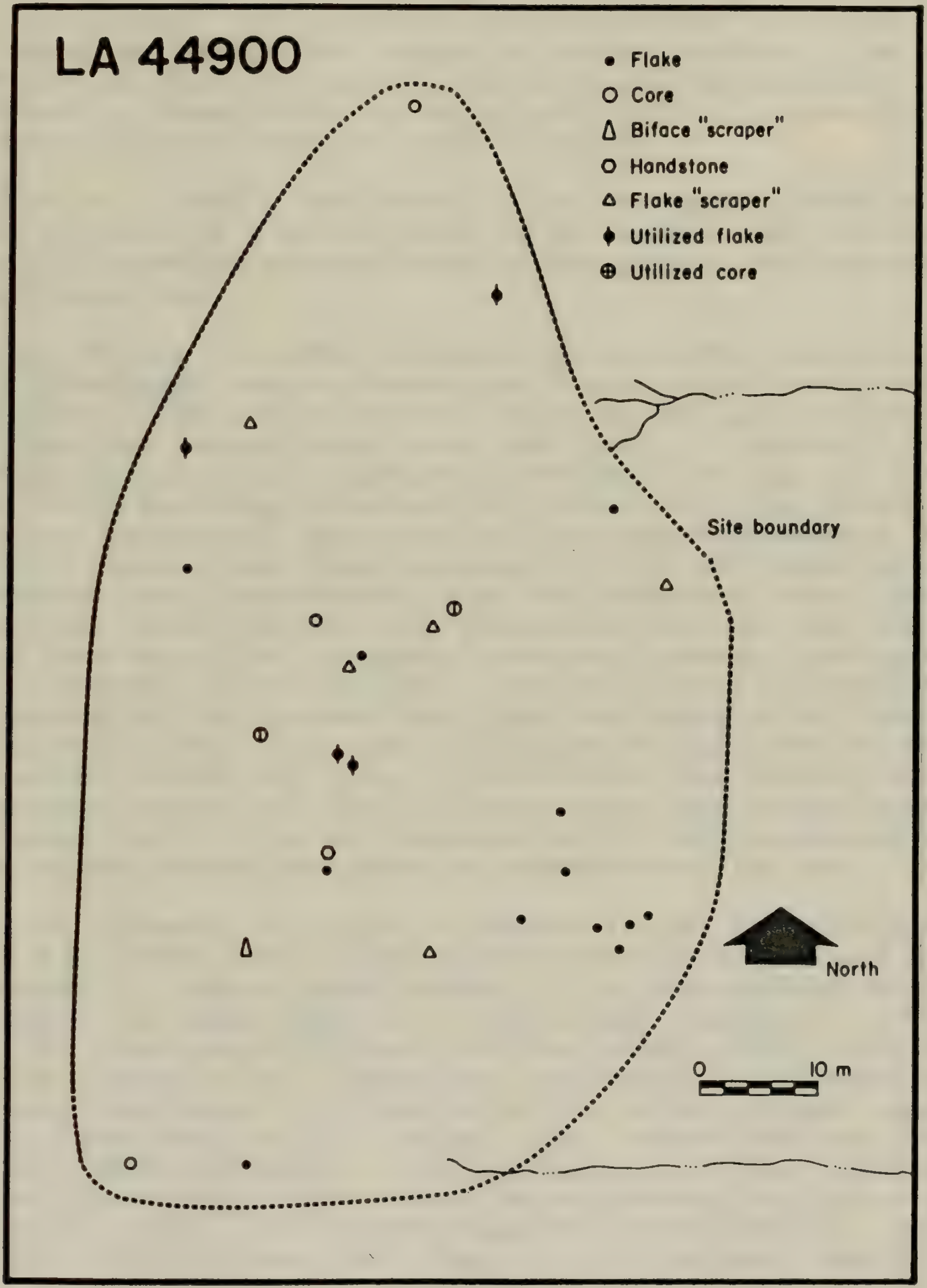


Figure 3.35 illustrates a Type 2B site (LA 44867) characterized by two distinct loci of activity. Both loci occupy similar areas, contain fire-cracked rock features, brownware ceramics and similar chipped stone tool assemblages. The variability in density may be related to the more denuded nature of the Locus 2 setting. The amount and diversity of cultural debris indicate a temporary camp function for both loci. This site may represent the product of two independent occupational episodes characterized by similar behavioral modes or conversely, may represent contemporaneous occupation by two spatially segregated social units engaged in similar activities. The potential for buried cultural debris between the two loci cannot be eliminated. Site LA 2531 described by Fenenga and Cummings (1956:219-220) presumably resulted from activities similar to those conducted at LA 44867.

The situation at LA 44880 is less certain. This is a highly eroded locale that may be an extension of a nearby (also highly eroded) Type 2C site. The eroded setting is presumably responsible for the relatively small assemblage in a moderately large area.

Another Type 2B site (LA 45459) is a relatively dense lithic and sherd scatter with eight fire-cracked rock or charcoal and burned earth hearth and roasting pit features. The hearth features range in size and composition from small charcoal and burned earth areas one meter in diameter, to dense concentrations of burned and fragmented limestone of varying size (2m to 6m in diameter) with one large (9m diameter) burned rock ring midden. This latter feature presumably represents the backdirt surrounding a large roasting pit. Burned bison bone is common at this site indicating that the hearth features were predominately used for processing faunal resources. The assemblage, faunal remains, and features indicate that this site was a repetitively used locale for processing bison and perhaps other resources. This site presumably represents a type complementary to the bison kill site type represented by the Garnsey Site (Speth and Parry 1978, 1980; Speth 1983). Both sites contain brownware and Chupadero Black-on-white ceramics. Several hundred meters away from LA 45459 bovid bone (bison?) was noted eroding out of an arroyo cut (1m to 1.5m below the surface for roughly 25m along the arroyo cut). This may represent the kill locus associated with LA 45459. No cultural material was noted in association with the bone.

Site Type 2H represents a unique occurrence in the Abo survey cultural resources. It is a lithic scatter site (LA 45452) situated in protected limestone sink enclosure in a rolling plains setting. It is characterized by a mixed chipped stone tool assemblage and lacks milling equipment and hearth features. Its uniqueness is derived from the presence of a series of stone ring features (Figure 3.36). These are constructed from locally available limestone blocks and range from 3.5m to 6m in diameter. These features are traditionally interpreted as "tipi rings" (e.g. Jelinek 1967:160; Scurlock 1979:195-198; Camilli 1979:90,93). The size range of the Abo rings compares favorably with the range in size (3m to 6m) documented for similar features identified as tipi rings at Los Esteros Reservoir (Camilli 1979:93). However, it is possible that the Abo rock rings do not represent shelter-related features. In his discussion of hide working activity and site structure Binford (1983:172) notes that:

Figure 3.35
LA 44867, A Type 2B Site that Contains Two Discrete Loci.

Both are characterized by flake debris, sherds, chipped stone tools, and remnant hearth features. Whether this spatial segregation is the result of multiple contemporaneous social units or reuse of the site is undetermined. Also, testing would be necessary to determine if the two loci are indeed separate and not joined by subsurface deposits.

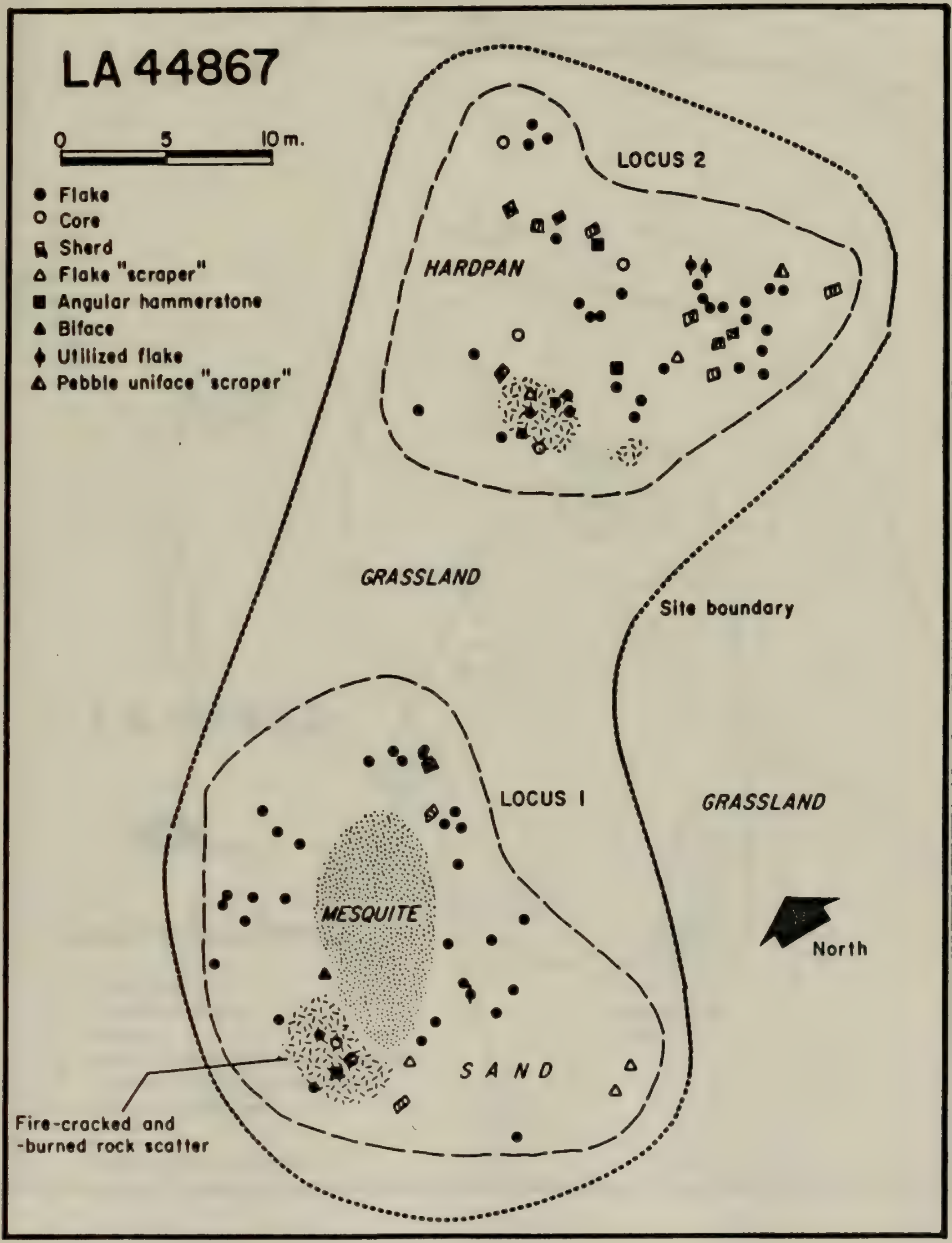


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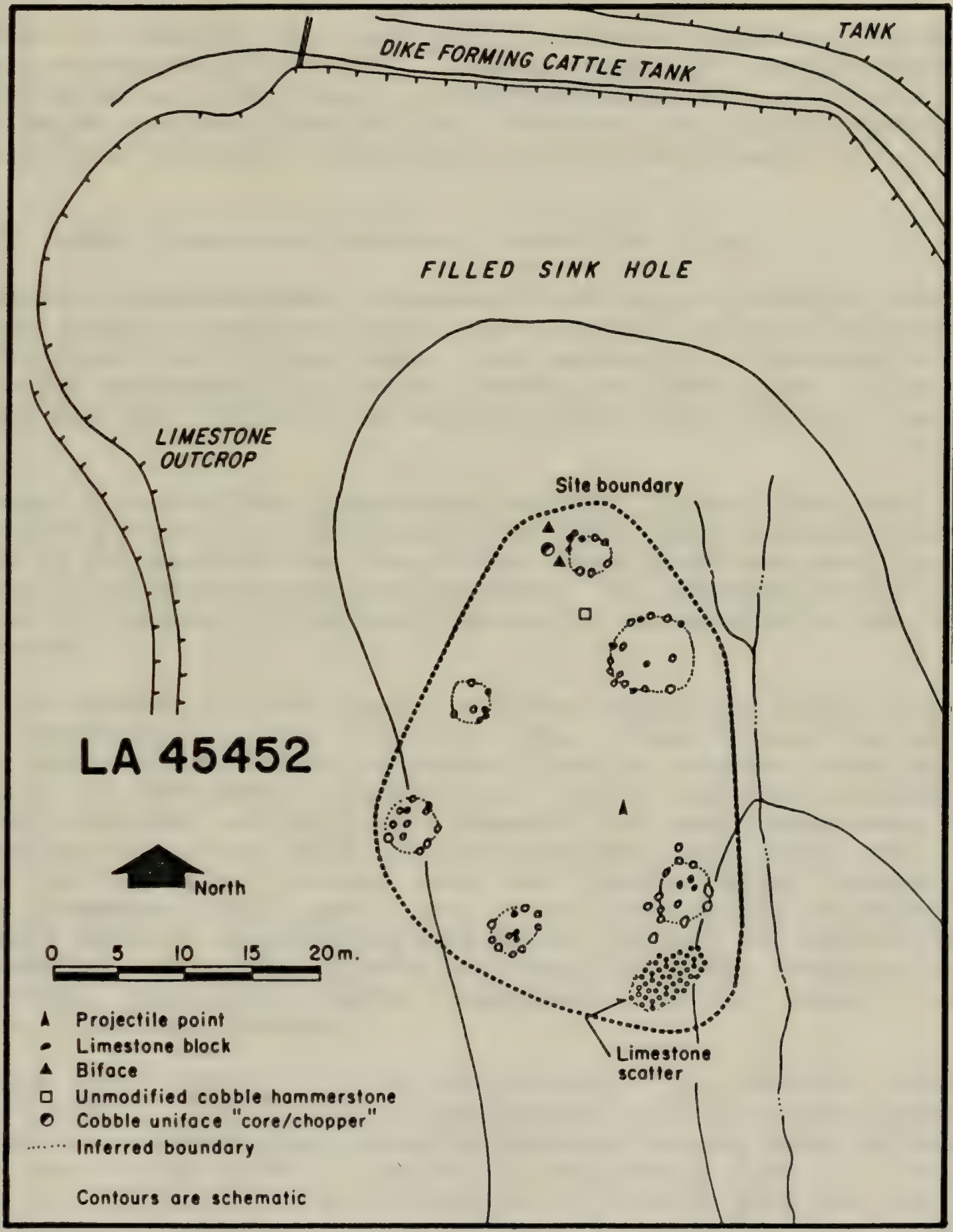
Figure 3.36
LA 45452, A Type 2H Site

Characterized by a sparse chipped stone tool assemblage and a series of rock ring features. The features may represent "tipi rings" or they may be the result of hide processing activities.



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> It is not uncommon for rather flat ground to be selected for hide working and for stones to be cleaned back from the chosen area if it is rocky; the 'ring' of stones produced in this way may subsequently be used as weights to secure the hide. In most cases, an archaeologist would interpret such a pattern as a tent ring or would infer the existence of some kind of structure from piles of stone which in reality had simply been removed to clear a surface for hide working.

LA 45452 is relatively flat and rocky, and the assemblage indicates an emphasis on hunting related tasks. Also, tipi rings are typically identified as late prehistoric and early historic period phenomena (Jelinek 1967:169; Camilli 1979:88,90,94; Scurlock 1979:195-198). However, the single projectile point recovered from this site is potentially an Archaic period point.

3.3.3.3 Lithic Procurement-Workshop Locales: Site Type 3

This class of sites collectively represents 9.23% of the prehistoric site types. The sites appear to represent areas where naturally occurring lithic materials were exploited for chipped stone tool production. Although there is considerable variability and overlap evident in these sites, three rough subtypes have been identified on the basis of size and intensity of use (Table 3.18).

The large, extensive lithic procurement-workshop locales (Type 3A) are the most commonly represented and account for 5.38% of the prehistoric site total, followed by the moderate size sites (3.08% of the prehistoric sites) and small size sites (0.77% of the prehistoric site total). The difference in size appears to be related primarily to the areal distribution and quantity of the potential tool materials.

There are several different types of source locales for chipped stone tool material represented in the Abo study area. These include the extensive terrace gravels (mixed cobbles or pebbles) that are abundant along the Pecos River and its tributaries. Cobbles and pebbles are also available from scattered pediments and lag gravel deposits that occur along some of the Pecos tributaries and as isolated patches throughout the study area. These gravels are most likely derived from the Tertiary Period Pliocene Epoch Ogallala Formation. The pink, red, maroon and purple quartzites that distinguish many of the observed Abo survey artifacts are characteristic of this formation which also includes a variety of other materials as well (miscellaneous quartzites, cherts, chalcedonies, jasper, basalt, petrified woods and indurated sandstone).

The other major source of lithic tool material is the Permian Period San Andres Formation. This formation occurs primarily in the western portion of the study area, and is characterized by limestone deposits which differentially contain chert. The chert is typically a homogeneous light to dark gray, ranging to a marbled or mottled gray, tan or brownish gray and white, and sometimes tightly banded grey, white or tan ("fingerprint chert"). The gray oxidizes to a light tan when exposed to weathering agents. The variability in

Table 3.18
Site Type 3 Analytical Variables
(N = 12)

Sub-Type	Site Number	Size (m^2)	No. of Tools	No. of Flakes	Flake/Tool Ratio	Tool Diversity Index	Lithic Source Materials
3A	LA 44882	360,000	2,560	2,900	1.13	75.29	Gravel terrace
	LA 45462	320,000	1,250	1,850	1.48	104.16	Lag gravel - capped low ridge
	LA 45495	120,000	466	2,100	4.50	51.77	San Andres chert, lag gravels
	LA 45460	92,000	140	500	3.57	35.00	River terrace gravels
	LA 45454	90,000	240	1,133	4.72	60.00	San Andres chert
	LA 45493	75,000	4,500	15,900	3.53	321.42	San Andres chert
	*LA 33079	60,000	?	?	?	?	River terrace gravels
3B	LA 44866	13,000	54	380	7.03	2.57	Remnant terrace gravels, slope
	LA 44864	11,000	25	41	1.64	1.56	Remnant terrace gravels, sand
	LA 44869	7,000	43	204	4.74	2.38	Remnant terrace gravels, ridge
3C	LA 44868	2,925	27	66	2.44	1.68	Remnant terrace gravels, knoll
	LA 45457	700	7	20	2.85	1.40	Lag gravels, slope

* Previously recorded

the degree of this oxidation (patination) on stone artifacts may have utility for relative dating. The occurrence and quality of the San Andres chert varies considerably throughout the formation and presumably influenced the use of this resource by prehistoric stone knappers.

The majority of these locales are considered to represent the accumulation of debris from repeated use through time (particularly the Type 3A and 3B sites). They were presumably locales visited on an as-needed basis for the procurement of chipped stone tool material for use in a variety of tasks. As such they are considered palimpsest quarry sites - locales where prehistoric knappers selected and tested potential tool material and also performed some preliminary reduction or rough shaping of flakes, cores and tool blanks or preforms for use elsewhere. Furthermore, the number of tools or retouched artifacts noted at these locales indicate that they were also the location of a variety of task specific or limited activity tool use events. As such they are additionally identified as "workshop" locales. There is consequently apt to be a fair degree of overlap between the smaller Type 3 sites and some of the sites identified as Type 4 locales. It is probable that some of the Type 4 sites (particularly Types 4A, 4B, 4D and 4E) which occur in or near lithic resource areas would be more appropriately classed as Type 3C sites. Figure 2.2 illustrates an extensive lithic procurement-workshop site situated on the Blackdom Terrace overlooking the Pecos River. The areal extent of this site corresponds roughly to the distribution of exposed gravels on the terrace. The density and distribution of artifacts varies considerably within this site, a characteristic that is common for most of the large lithic procurement sites.

Figure 2.3 illustrates the distribution of cultural debris in one of the more concentrated areas (locus 2) at LA 44882. This area may be representative of a limited activity workshop locus or possibly the scene of a small temporary camp.

Figure 3.37 illustrates a moderate size (Type 3B) lithic procurement-workshop locale (LA 44869). Note the variability evident in the distribution of cultural debris at this site. LA 44869 is located on an isolated gravel terrace remnant several miles west of the Pecos River. This site, along with several others in the general vicinity (LA 44864, LA 44866, and LA 44868) were presumably exploited by individuals camping or working locally. One of these sites (LA 44868) may represent a camp locale where the exploitation of the locally available cobbles and pebbles was a common activity. It is situated on and adjacent to a gravel-capped ridge and much of the site area is in a protected sandy area conducive to camping.

3.3.3.4 Limited Activity Locales/Task Specific Campsites: Site Type 4

This is a diverse class of lithic sites which occur throughout the Abo study area and together comprise 33.08% of the prehistoric site total. The sites in this category are considered representative of a variety of diverse functional groups and have been divided into five subtypes based on assemblage content. There is a considerable amount of diversity evident within and among these five subtypes (Table 3.19). This variability is presumably due

Figure 3.37
LA 44869, A Type 3B Site

A moderate size lithic procurement-workshop site located on a gravel terrace remnant several miles west of the Pecos River. Note the variable distribution of cultural debris evident at this site.

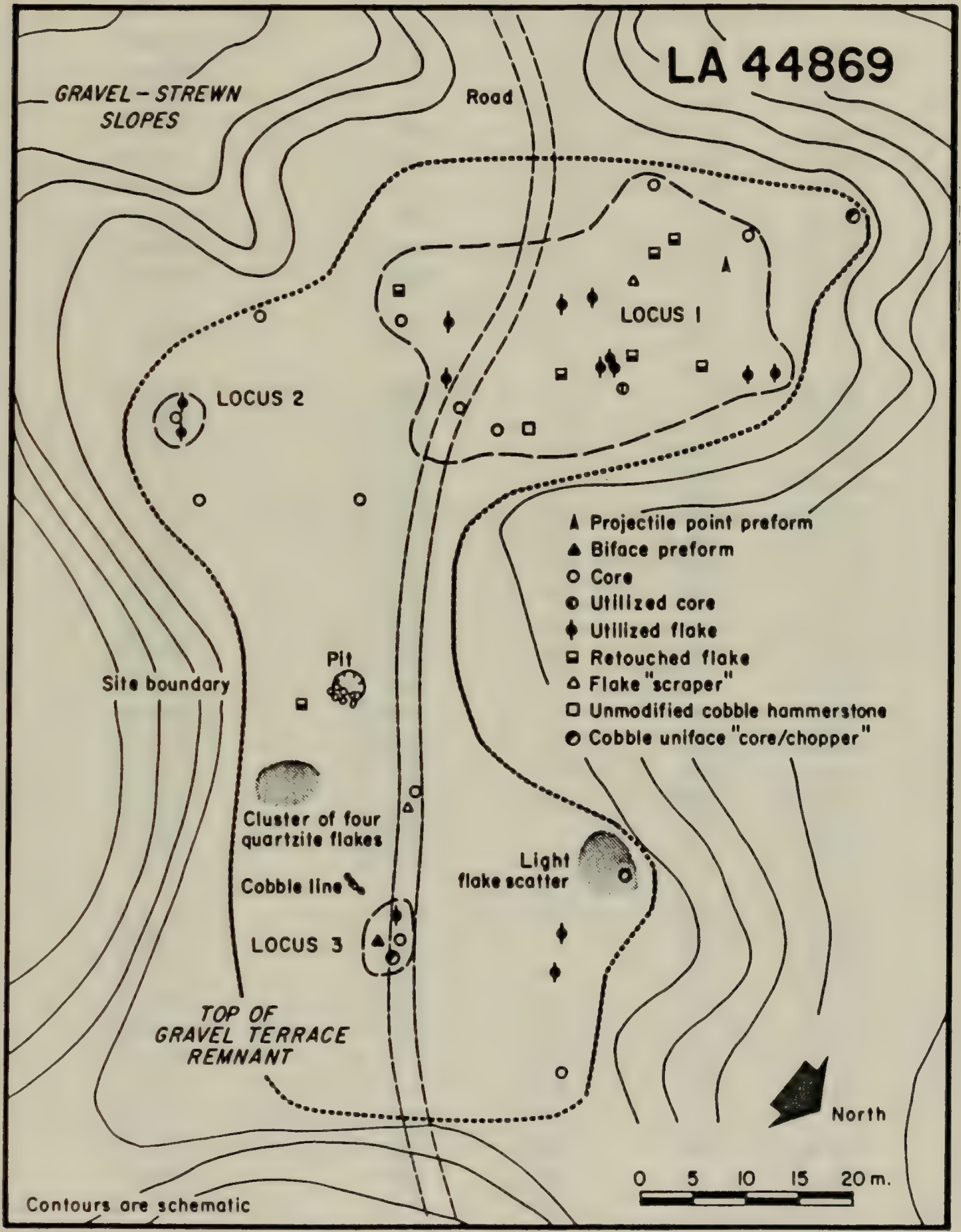


Table 3.19
Type 4 Sites; Analytical Variables

			No. of Artifacts			
Subtype	Site No. LA-	Size (m^2)	Tools	Flakes	Flake/ Tool Ratio	Tool Diversity Index
4A	45494	7,564	3	30	10.00	1.00
4B	44856	1,120	3	8	2.66	1.00
	44862	300	3	5	1.66	1.50
	44905	9,000	1	29	29.00	1.00
	45478	760	4	25	6.25	1.00
	45466	8,432	3	83	27.66	1.50
	45473	1,512	5	19	3.80	1.66
	45485	400	3	17	5.66	1.50
	45497	1,440	8	22	2.75	2.66
	45470	1,269	2	13	6.50	2.00
4C	44863	40	1	14	14.00	1.00
4D	44893	800	2	6	3.00	1.00
	44903	4,550	4	114	28.50	2.00
	44904	8,000	11	123	11.18	1.83
	44912	825	4	42	10.50	2.00
	44875	11,488	23	77	3.34	1.91
	44881	3,375	11	14	1.27	1.83
	44891	2,475	6	16	2.66	1.20
	45456	7,200	16	68	4.25	6.80
	45477	18,800	14	344	24.57	1.55
	45442	2,640	49	390	7.95	2.57
	45451	550	5	44	8.80	1.66
	45453	1,584	8	12	1.50	1.14
	45486	3,360	10	24	2.40	2.00
	45487	1,400	6	41	6.83	1.20
	45488	23,040	11	2,300	209.09	1.83
	45489	1,080	5	190	38.00	1.25
	45491	5,704	7	4	0.57	1.40
4E	44870	1,250	10	170	17.00	2.50
	44873	600	3	12	4.00	1.00
	45471	630	1	22	5.50	2.00
	45475	1,536	7	19	2.71	1.16
	45476	4,864	15	20	1.33	1.25
	45439	4,320	17	49	2.88	1.54
	45440	2,340	12	26	2.16	1.50
	45441	1,080	12	18	1.50	1.20
	45443	18,700	25	50	2.00	3.12
	45490	5,000	200	80	0.40	16.66
	45492	1,050	8	71	8.87	1.60

Note: there are an additional four previously recorded sites which are classed as general Type 4 subtype undetermined sites: LA 25679, LA 27645, LA 37563 and LA 38127.

to a series of different factors including site function, intensity of use, post occupational deposition or erosion and sampling bias.

These sites are collectively considered the result of a variety of task specific and short-term limited activity episodes which probably span the occupational history of the region. They are generally (but not always) relatively small sites characterized by aceramic lithic scatters. These range from flake scatters associated with a single flaked stone implement to flake scatters with multiple tools representing several different tool classes. Some presumably represent single event activities such as core reduction or tool use and maintenance. Others are indicative of multiple activities, including variable combinations of core reduction and manufacture or resharpening of bifaces, unifacial tools and cobble tools. Some assemblages include flake debris and various flaked stone tools, many of which, by themselves, are functionally ambiguous (e.g., utilized flakes, marginally retouched flake unifaces, cobble unifaces, etc.). These include the Type 4A, 4B, and 4E sites. Other Type 4 sites include projectile points, bifaces, and other more functionally specific flaked stone tools (Types 4C, 4D) which facilitate functional identification or interpretation. The Type 4 sites are discussed below in order of decreasing frequency as indicated in Tables 3.9 and 3.19.

The 4D sites account for 13.08% of the prehistoric sites and are the most commonly occurring limited activity locales or task specific campsites. These sites are lithic·scatters characterized by flake debris and a mixed stone tool assemblage that includes projectile points or bifaces (or biface reduction flakes also). These sites potentially functioned as hunting-related staging or processing locales. That is, the projectile points presumably represent hunting weaponry, the bifaces are skinning and butchering tools, and the various chipped stone tools may be indicative of further processing beyond primary butchering (e.g., meat, marrow or hide preparation, and repair and maintenance of tool kits).

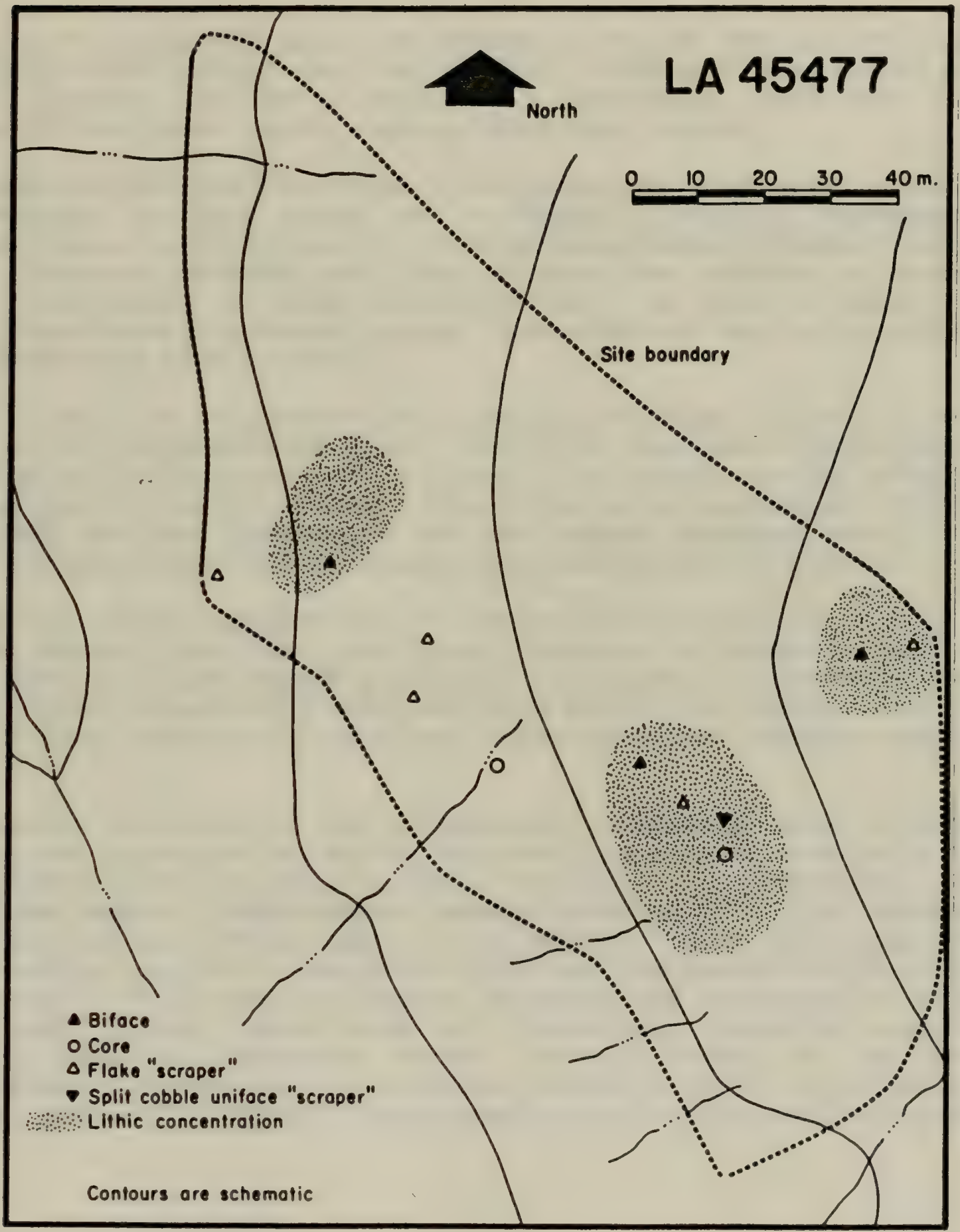
The designation "hunting-related" is based on the assumption that projectile points and bifaces are part of a hunting tool kit. It is possible that hunting may only be the most visible activity remaining in the archaeological record at these sites and that additional activities were performed for which no readily identifiable residue remains. Also, it is assumed that bifaces may have functioned in a variety of tasks not necessarily related to hunting. Therefore, some of these sites may represent limited activity workshops or short-term camp locales where activities other than those related to hunting occurred.

Figure 3.38 illustrates a multi-loci Type 4D site (LA 45477). The assemblage content exhibited by the three clusters of artifacts is remarkably consistent. The limited number of tools and repetitive nature of the loci assemblages are considered an indication that this site was task specific. Whether the three loci represent functionally similar contemporaneous events or temporally distinct yet functionally similar repetitive episodes is uncertain.

Site Type 4E accounts for 8.46% of the prehistoric site total. These are sites characterized by flake debris and a mixed flaked stone tool assemblage exclusive of projectile points, bifaces or biface reduction flakes. They are

Figure 3.38
LA 45477, A Multi-Loci Lithic Scatter Type 4D Site.

Note the assemblage similarity between loci.
This is a light scatter of flakes which defines the site area.



similar to the Type 4D sites in size range and assemblage size and diversity, and except for the lack of "hunting-related" artifacts may have functioned in similar capacities. Collectively, these sites are considered representative of limited activity locales including task specific workshops, lithic procurement locales, and short-term camps. They are presumably locations where one or more of a variety of short-term activities (tool use and maintenance, lithic procurement, overnight camping, etc.) were carried out.

Figure 3.39 illustrates a small, low diversity Type 4E site (LA 45471). The assemblage and relatively small size indicates a task specific or limited activity locale. However, the site is located in a depositional environment (alluvial stream terrace) which may be masking subsurface deposits.

The Type 4B sites represent 6.92% of the prehistoric Abo survey sites. They are indicated by flake debris and a chipped stone tool assemblage that includes cores, utilized flakes or small scraping-planing-chopping implements only. These are generally small sites (although two examples are moderately sized) characterized by small assemblage size. As with the other Type 4 sites, these were presumably locales where one or more of a variety of short-term tasks were conducted.

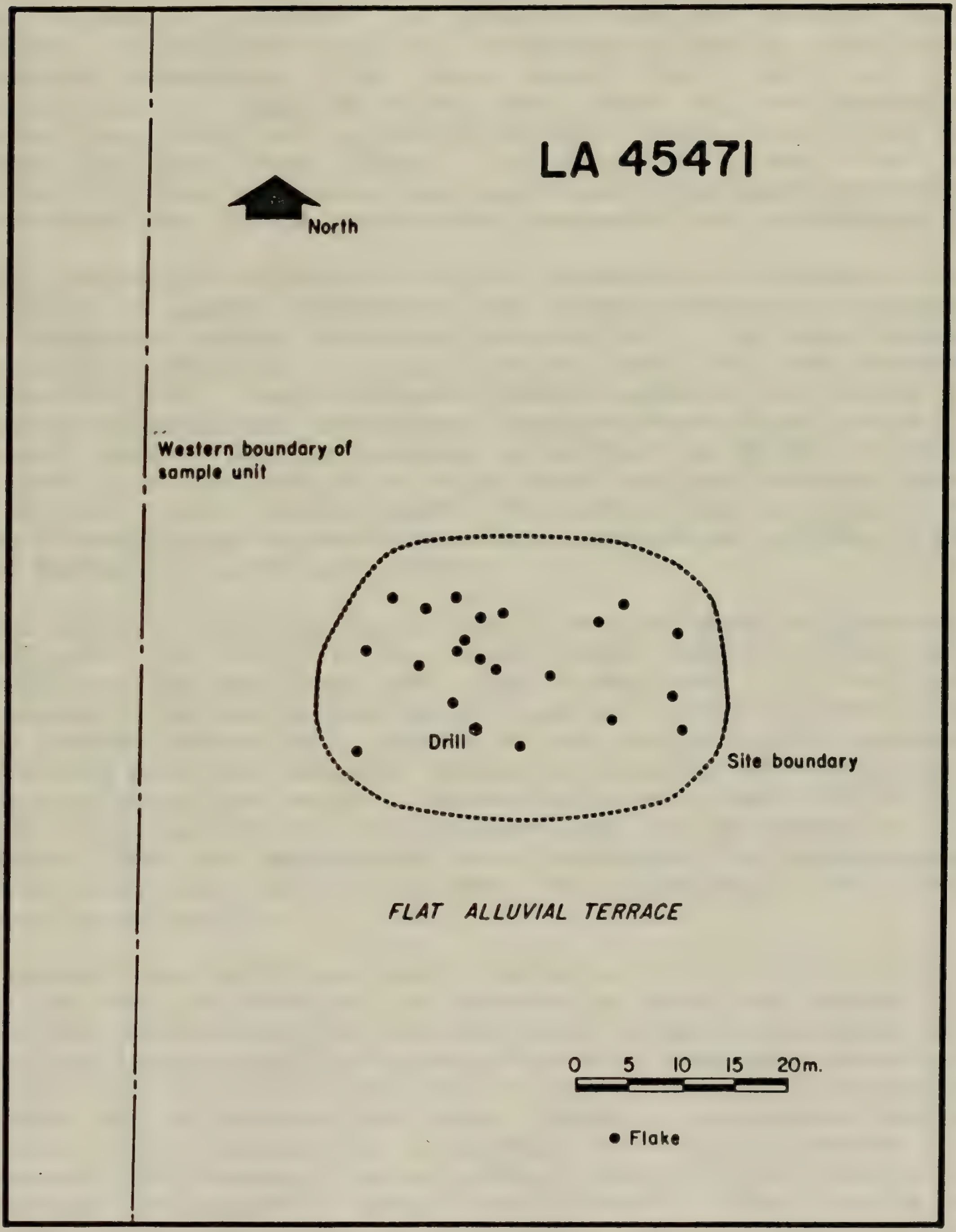
Type 4C sites are represented by a single occurrence accounting for only 0.77% of the prehistoric site total. This is a small site characterized by a single biface and a scatter of 14 flakes. The biface may be indicative of hunting-related behavior although this is not an unquestionable assumption. The small site size, assemblage size and content indicates this is a task specific limited activity locality presumably resulting from a single event.

Site type 4A is also represented by a single site distinguished by three cores and 30 flakes. This site may simply represent a limited activity locale characterized by tasks requiring flakes only. However, the cultural debris is scattered over a moderately large area on a broad alluvial stream terrace and there is good potential that additional, more diversified cultural remains are buried.

In summary, the class of Type 4 apparently includes a series of different specific site types that presumably represent a continuum from single event, task-specific locales to limited activity workshops and short-term, possibly special use camps. Differentiation between a limited activity or task-specific locale versus a short-term camp is often difficult. Size, assemblage content and diversity, and site structure attributes are considered critical variables. Smaller size, coupled with low internal diversity, are considered indicative of task-specific locales; larger sites with functionally diversified assemblages probably represent short-term camps. However, these are not absolute differentiating criteria and considerable overlap can be expected in the content, size and organization of task-specific locales and short-term camps.

Figure 3.39
LA 45471, A Small, Low Diversity Lithic Scatter Type 4E Site

This site potentially represents a small task specific or limited activity locus. However, the site setting on a broad, open alluvial stream terrace could be indicative of a more extensive buried cultural deposit.



3.3.3.5 Site Types Not Represented in the Abo Study Area

In addition to the site types identified during the Abo project survey there are several other prehistoric site types that have either been documented within the study area or from adjacent areas. The proper identification, evaluation and investigation of these highly variable site types is considered critical for a thorough understanding of the prehistory of the Abo study area. They include large "mound" sites associated with pithouses and developed sherd and lithic midden deposits. The mounds are the remains of adobe roomblocks (pueblos) and together with the pithouse structures represent the domestic focus of sedentary pueblo or Mogollon period agricultural communities. The Bloom Mound (Kelly 1966) and a nearby unnamed mound site along the Hondo River (Ross 1975) are characteristic of this site type. They were apparently occupied between roughly AD 1250 and possibly AD 1450 (Ross 1975). As noted by Stuart and Gauthier (1981:268,270) these sites are a rare occurrence in southeast New Mexico, and their absence from the Abo survey site inventory is not unanticipated.

Another sedentary community site type is represented by pithouse remains or the remains of shallow semisubterranean rooms occasionally associated with small contiguous surface structures (Jelinek 1967). In some instances the only surface manifestation of these sites are sherd and lithic concentrations (Jelinek 1967:120). These sites are typically located in or adjacent to areas conducive to agriculture, particularly along the Pecos River terraces. They apparently made an initial appearance during the Late 18 Mile phase (ca. AD 900 - 1000) and continued to be in use until the Late McKenzie Phase times (ca. AD 1250 - 1350) (Jelinek 1967). The lack of this site type in the Abo survey inventory may be related to bias in the sample universe, undetected buried features, or settlement patterns.

Another site type noted in the Abo study area are bison kill localities. The Garnsey site (LA 18399) is one example that has been fairly intensely investigated (Speth and Parry 1978, 1980; Speth 1983). This late prehistoric - protohistoric site was apparently the scene of a series of bison kill events. It was initially exposed in an arroyo cut and the subsequent excavation has demonstrated that some secondary processing activities were conducted at the site in addition to the major kill-related activities (Speth and Parry 1980). Another site along Salt Creek (LA 34150) may be representative of similar activities. This site has recently been investigated by archaeologists from the Museum of New Mexico Laboratory of Anthropology and a report is currently in preparation.

It is possible that bovid bone noted eroding out of the arroyo cuts in Sample Units 5-25-24-6 and 7-25-29-5 is indicative of bison kill locales. A large sherd, lithic and roasting pit site (LA 45459) with an abundance of burned and unburned bone including fragments obviously from large mammals (bison?) and bison teeth in Sample Unit 5-25-24-6 may represent the processing locale associated with the potential kill locus. Similarly, an Archaic component at LA 44874 which contains an assemblage potentially indicative of game procurement and processing is in relatively close proximity (500 meters) to the exposed bone deposit in Sample Unit 7-25-29-5. This situation may also be duplicated in Sample Unit 9-24-24-1 where there is a potential processing

site (LA44861) located in relatively close proximity to where bovid bone was noted eroding out of the side walls of several sinkholes. However, this latter situation is less certain as the bone may represent Bos sp. remains rather than bison.

Rock art sites constitute another class of cultural resources anticipated in the Abo study area. For example, a petroglyph locale (LA 39955) has been recorded along Railroad Mountain just east of the study area. This includes both historic and prehistoric rock art and is associated with a series of stone structural remains. As Clifton (1983) notes, rock art sites are rare in the Mescalero Pediment area as are sites with structural remains, and such sites should be considered very significant.

One other class of sites known from the Abo study area not included in the survey inventory are rockshelters. These are, of necessity, restricted to those areas characterized by overhanging rock outcrops, ledges, canyons and cliffs. One example is known from the study area. This is an apparently unrecorded (?) site in Rock House Canyon (T7, R23, Section 19, NW¼ of SE¼) that is characterized by a shallow rockshelter with an associated sherd and lithic deposit. The shelter also contains a boulder covered with a series of incised lines and gouged or ground pits (cupules). In addition there is a cluster of bedrock milling features on a rock shelf in front of the shelter. The constellation of these attributes (occupied rockshelter, rock art, bedrock milling features) makes this site a unique occurrence within the study area, and a site type of potential importance to the interpretation of the area's prehistory.

In addition, there may be other, as yet undiscovered or unrecorded, site types within the Abo study area. Future researchers should be prepared for this eventuality, and maintain flexibility in their recognition of site variability.

3.4 CULTURAL/TEMPORAL VARIABILITY

Cultural/temporal affiliation could be assigned to 48 (36.9%) of the newly discovered sites identified by the Class II survey representing 61 occupational components. Temporal placement is based on diagnostic projectile points and ceramics. The ceramics identified among the Abo survey sites is presented in Chapter 3.2.1; the projectile points are illustrated and discussed below. The distribution of the cultural/temporal components is summarized in Table 3.20. As shown in this table, the chronological range to which the components could be assigned varies considerably. This variability is a function of the number and kinds of diagnostic artifacts present within the sites. For example, some ceramics and projectile point styles span considerable time ranges, yet many sites contained only a projectile point or a few sherds from a single vessel. Also, for Formative period sites, very few components could be assigned to a specific phase due to insufficient diversity and quantities of sherds to utilize Jelinek's (1967) ceramic seriation-based sequence. Other factors also mitigate against cultural/temporal placement accuracy within the Abo area. First, the exact calendrical range of stylistic persistence for most projectile point and

ceramic types has not been firmly tied to an absolute chronology using chronometric methods (e.g., radiocarbon dates). Second, artifact collecting and other forms of vandalism have undoubtedly reduced the incidence and kinds of diagnostic artifacts that were originally present on many of these sites. As a consequence, the cultural/temporal and chronological ranges presented in Table 3.20 should be considered tentative.

Table 3.20
Cultural/Temporal Distribution Summary
for the Abo Sample Survey Sites

Cultural/Temporal Category	Approximate Age	Number of Components	Percentage of Datable Components
Late Paleoindian	7000 - 5000 BC	1	1.6%
Late Paleoindian or Early Archaic	6000 - 4000 BC	1	1.6
Early Archaic	5000 - 3000 BC	1	1.6
Early/Middle Archaic	4000 - 2000 BC	1	1.6
Middle Archaic	3000 BC - AD 1	2	3.3
Late Archaic	AD 1 - AD 600	10	16.4
Late Archaic or Early Formative	AD 500 - AD 900	14	23.0
Formative	AD 600 - AD 1300	6	9.8
Post 18 Mile phase	Post-AD 1000	11	18.0
Mesita Negra phase	AD 1000 - AD 1200	3	4.9
Post-Mesita Negra Phase	Post-AD 1000	2	3.3
Roswell Phase *	AD 1250 - AD 1350	3	4.9
Roswell/Post-Roswell Phase	Post-AD 1250	3	4.9
Late/Post-Formative	Post-AD 1200	2	3.3
Post-Formative	Post-AD 1350	1	1.6

* The Roswell Phase corresponds to Jelinek's McKenzie Phase.

3.4.1 Projectile Points from the Abo Study Area

A total of 39 of the 121 Abo survey prehistoric sites include projectile points in their assemblages. Another four sites include undifferentiated biface - projectile points fragments in their assemblages (typically tip or thin, narrow midsection fragments). In addition, 25 isolated occurrences include projectile points.

Evidence for a Paleoindian occupation of the study area is potentially represented by an isolated point found in an eroded setting with four flakes and a biface fragment (IO 106). This is a lanceolate point with slightly convex sides, a concave base and ground basal edges (Figure 3.40a) . It has rudimentary fluting caused by the removal of several flakes off each face although this may simply reflect basal thinning. A Clovis, Belen, or, more likely, a Plainview affiliation is indicated (e.g., Jelinek 1967:88, Plate VII A,D; Judge 1973:86,87; Wormington 1957).

In addition, there are four projectile point fragments that may be representative of the Paleoindian period. These include three base fragments with ground lateral edges (Figure 3.40b,d,e). Two (Figure 3.40d,e) appear roughly similar. Both exhibit relatively poorly executed parallel flake patterns, slightly concave bases, roughly (not even) parallel sides, lenticular cross-sections, and are manufactured from fine-grained red quartzite. They could represent terminal Paleoindian point fragments or possibly basal fragments of early Archaic Jay or Bajada points (Irwin-Williams 1973).

The third basal fragment (Figure 3.40b) is ground along the base as well as the lateral edges. It is made from a mottled red chert (oxidized?) and characterized by a well-controlled roughly parallel flake removal pattern, straight base, slightly expanding straight sides with a possible slight shoulder, and a thin lenticular cross-section. It appears similar to Cody complex points (c.f., Judge 1973:Figure 9) of the terminal Paleoindian period or possibly could represent a basal fragment of an early Archaic point snapped just below the shoulders.

The remaining possible Paleoindian point is a midsection fragment (Figure 3.40f) of gray chert. The regularity of the parallel flake pattern, parallel lateral margins and regular lenticular cross-section is reminiscent of the narrow lanceolate points of the terminal Paleoindian period (e.g., Cody complex Eden points.

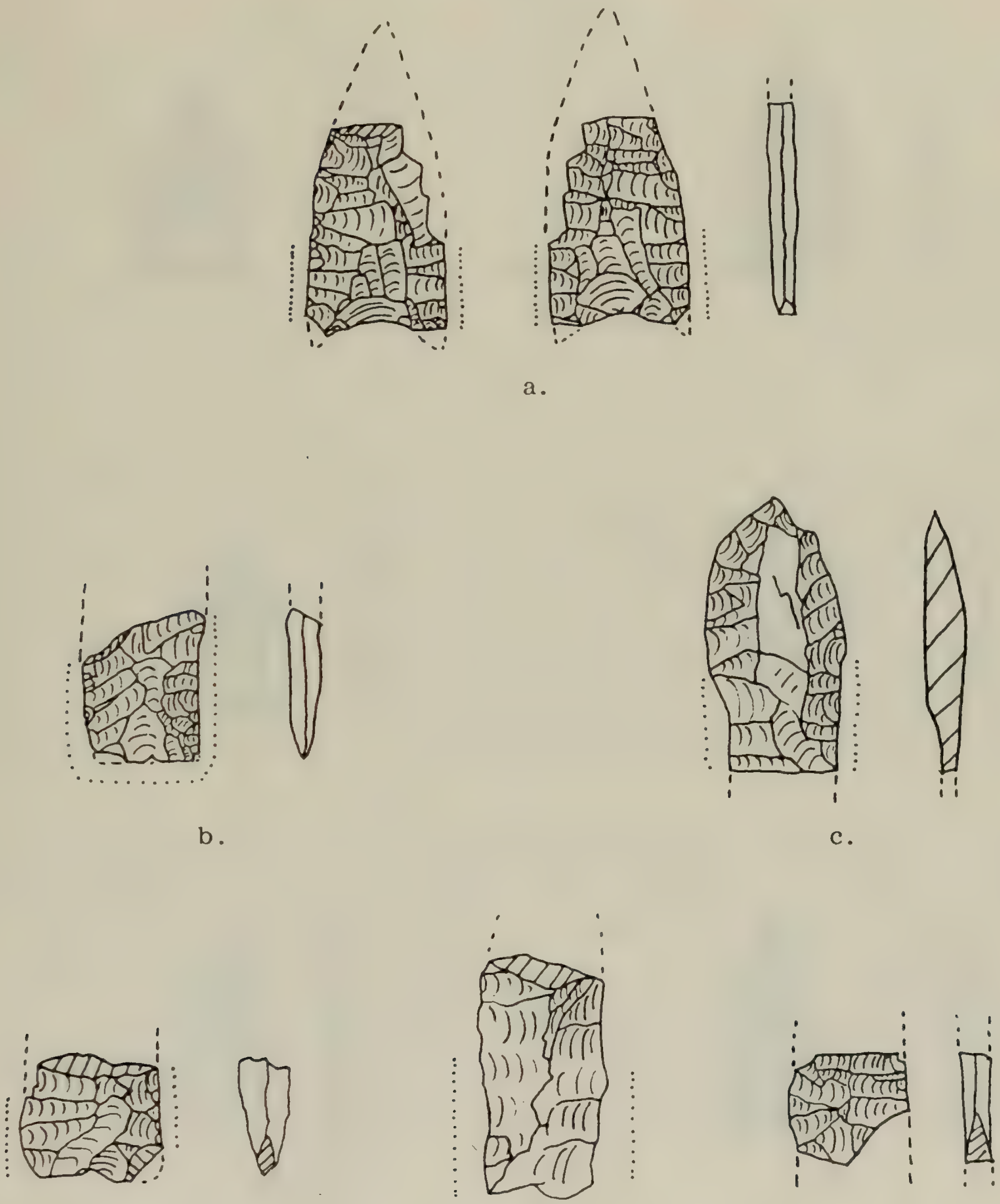
Three of the potential Paleoindian points came from a single site (LA 45468) which includes Archaic points (Figure 3.41b,c) in its assemblage. The other point (Figure 3.40e) is the only diagnostic artifact from LA 44861. (See Figure 3.49i for other possible projectile point from this site).

One specimen, lacking its base (Figure 3.40c) may represent an early Bajada-like point of Early Archaic affinity (Irwin-Williams 1973:Figure 3; see also Wimberly and Rogers 1977:191, 196). It is made of purple quartzite and is characterized by a regular parallel flake pattern, rough lenticular cross-section. It has a laterally edge-ground parallel-sided stem separated from the slightly broader convex-side blade by gentle, sloping shoulders. This point was discovered as an isolate.

Figure 3.40
Projectile Points

a. Isolated Occurrence #106
b. LA 45468 #29
c. Isolated Occurrence #242
d. LA 45468 #58
e. LA 44861
f. LA 45468 #23

(Dotted lines indicate ground edges)



a.

b.

c.

d.

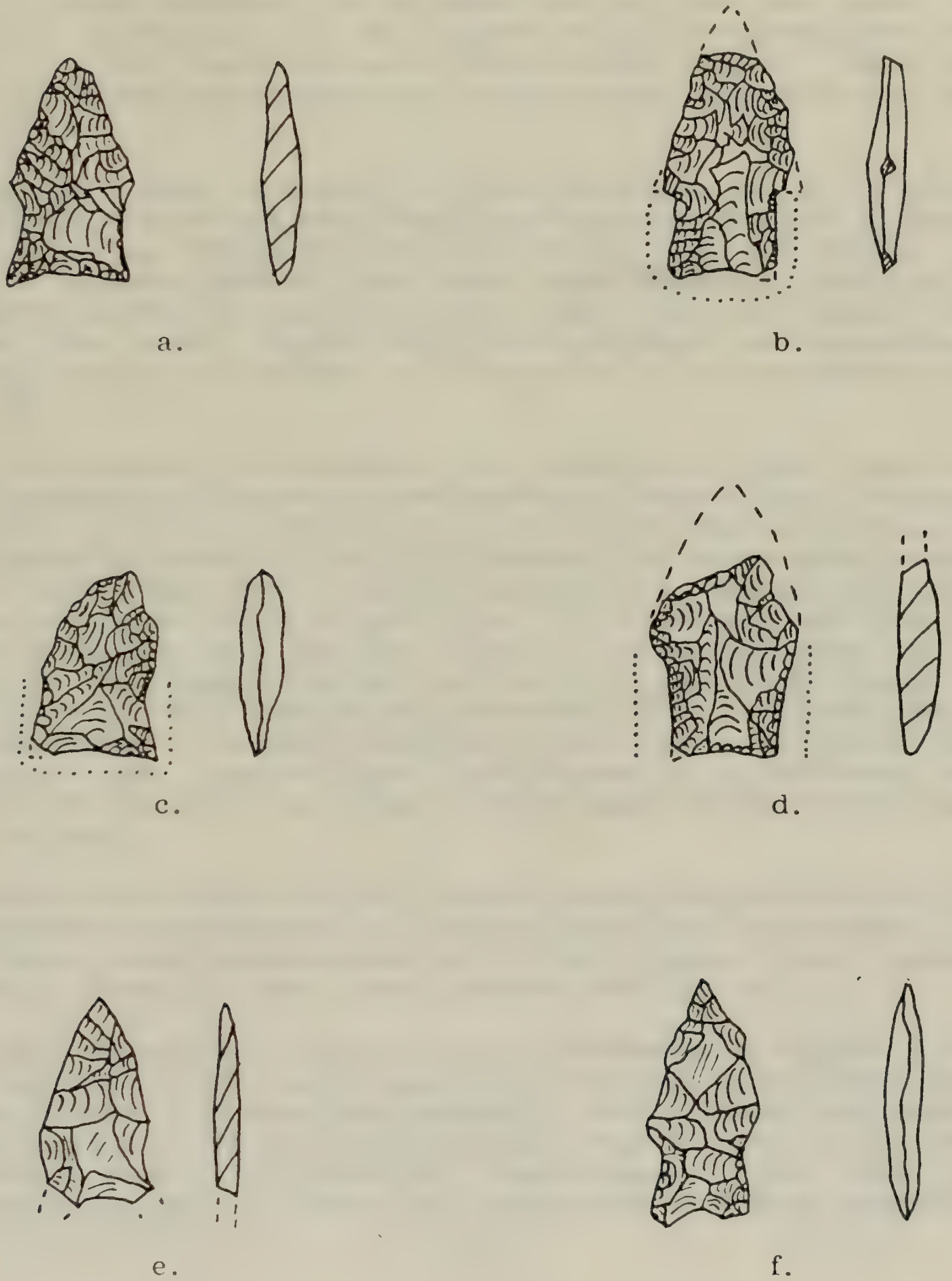
e.

f.

Figure 3.41
Projectile Points

a. LA 44874 #31
b. LA 45468 #1
c. LA 45468 #36
d. LA 44874 #25
e. LA 45474 #12
f. LA 44907 #4

(Dotted lines indicate ground edges)



a.

b.

c.

d.

e.

f.

Four points appear similar in size and morphology and are tentatively identified as San Jose-like points of the mid-Archaic period (Figure 3.41a-d). They are characterized by roughly triangular blades; almost straight to expanding stems; shoulders that are weak, slightly sloping or slightly barbed; and slightly concave bases. The four points are from two sites. Two from LA 45468 exhibit ground base and lateral stem margins. One from LA 44874 exhibits ground lateral stem margins. It is probable that all four have undergone varying degrees of resharpening. Jelinek (1967:Plate XVI,i) illustrates a similar specimen that he identifies as a San Jose point. Leslie (1978:146,148) illustrates points that appear similar (see particularly Figures 26A,B,D,C,I,J; 28A), and that he attributes to the Archaic. Leslie further indicates the basally ground specimens may be very early within the Archaic period (1978:148).

Two other Abo project specimens (Figure 3.41e,f)appear to be somewhat similar although both exhibit more deeply concave bases and lack ground stem margins. They are tentatively identified as San Jose (?) points. Leslie illustrates a somewhat similar point (with basal grinding?) with his early Archaic group (1978:148, Figure 28A:L). Also, they are similar to some Chiricahua phase points (Sayles 1983:120). Although not encountered by Jelinek, they would be identified as K3WZ points in his classification scheme (1967:94-96).

Figures 3.42 through 3.44 illustrate other probable Archaic points. The specimens illustrated in Figure 3.42 are similar to Leslie's Types 8-A and 8-B (1978:129-132) which he attributes to a pre-AD 950 Archaic horizon. They are most typical of Jelinek's Type C5XZ although the range would potentially include his Types B5XZ, H5XZ and J5XZ (1967:94-97). Jelinek notes that the C5Z forms only occur at his Archaic sites. It should be noted that similar points were recovered from Bat Cave (Type 5) where they occur with more frequency in the ceramic zones than in the preceramic zones (Dick 1965:24,25,30,31). Dick (1965:25,30) considered them a relatively late point type and notes their occurrence in Mimbres phase sites in the Mimbres Valley, New Mexico. Also, Irwin-Williams (1973:Figure 6,7) illustrates similar specimens which she attributes to the En Medio phase of the Oshara Tradition (800 BC - AD 400).

Other medium sized corner and side notched points (Figures 3.43 and 3.44) include specimens representative of Leslie's Type 5 and 6 categories. Leslie considers these points representative of the Late Archaic (Hueco phase) and early formative (early Querecho phase) periods (1978:118-126).

Another series of potential Archaic points is illustrated in Figures 3.45 and 3.46f. These are typically large lanceolate points with broad corner notching which has created a convex-base expending stem. These are similar to Leslie's Type 10B and 10C points and may date from the Late Archaic into the early Formative period (1978:138-142). One specimen (Figure 3.45c) resembles the "Maljamar" point of Corley and Leslie (1963); another (Figure 3.46f) may have been a drill.

Figure 3.42
Projectile Points

a. LA 45481
b. LA 45468
c. LA 44897
d. LA 45474 #8
e. Isolated Occurrence #267
f. LA 44908 #19
g. Isolated Occurrence #8
h. Isolated Occurrence #455
i. LA 45452 #1

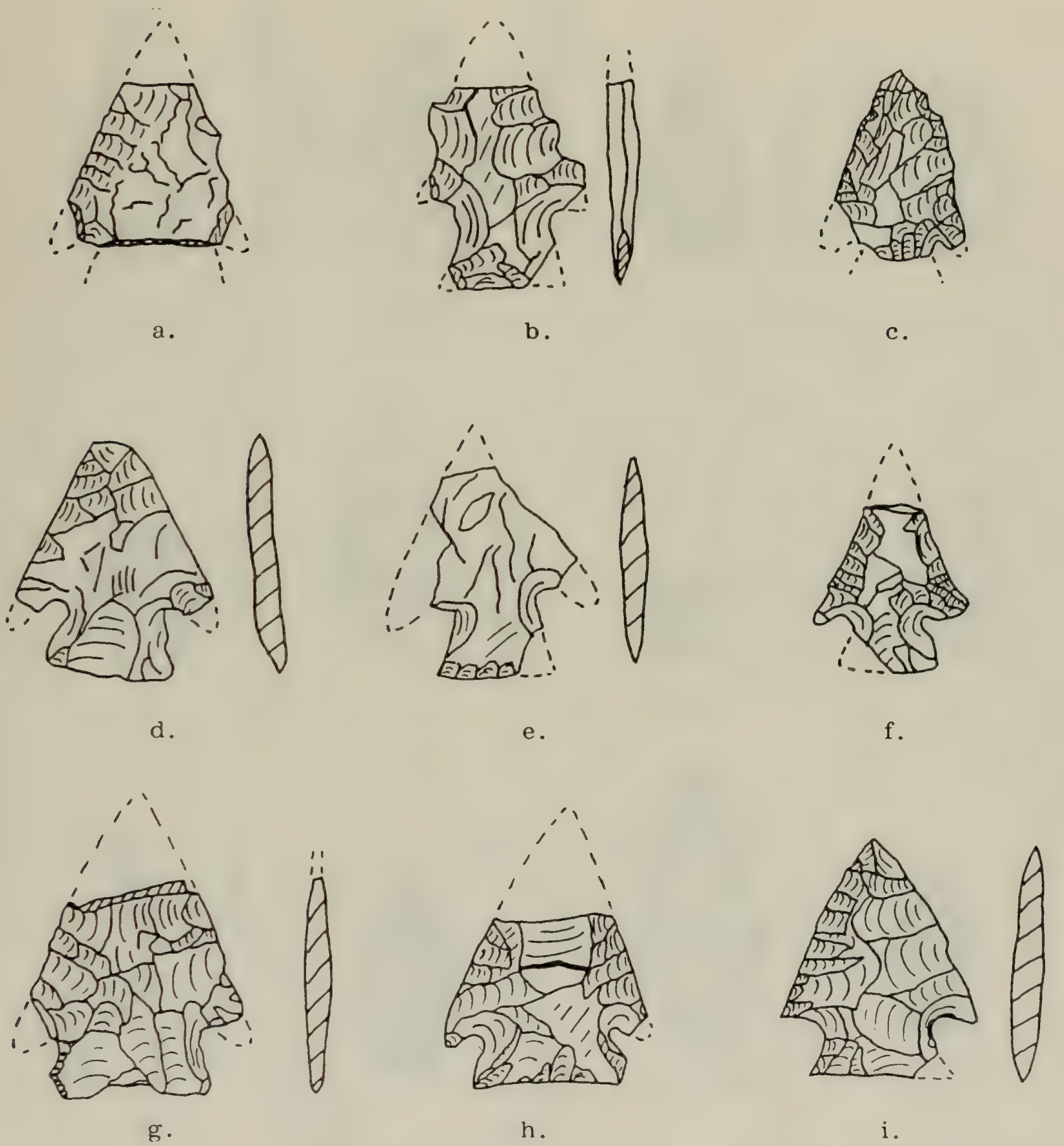


Figure 3.43
Projectile Points

a.	IO #194	b.	IO #231	c.	LA 45484
d.	IO #53	e.	LA 44892	f.	IO #268
g.	LA 44899	h.	LA 44876	i.	LA 44852 #10
j.	LA 45449	k.	LA 44858 #2	l.	LA 44858 #15

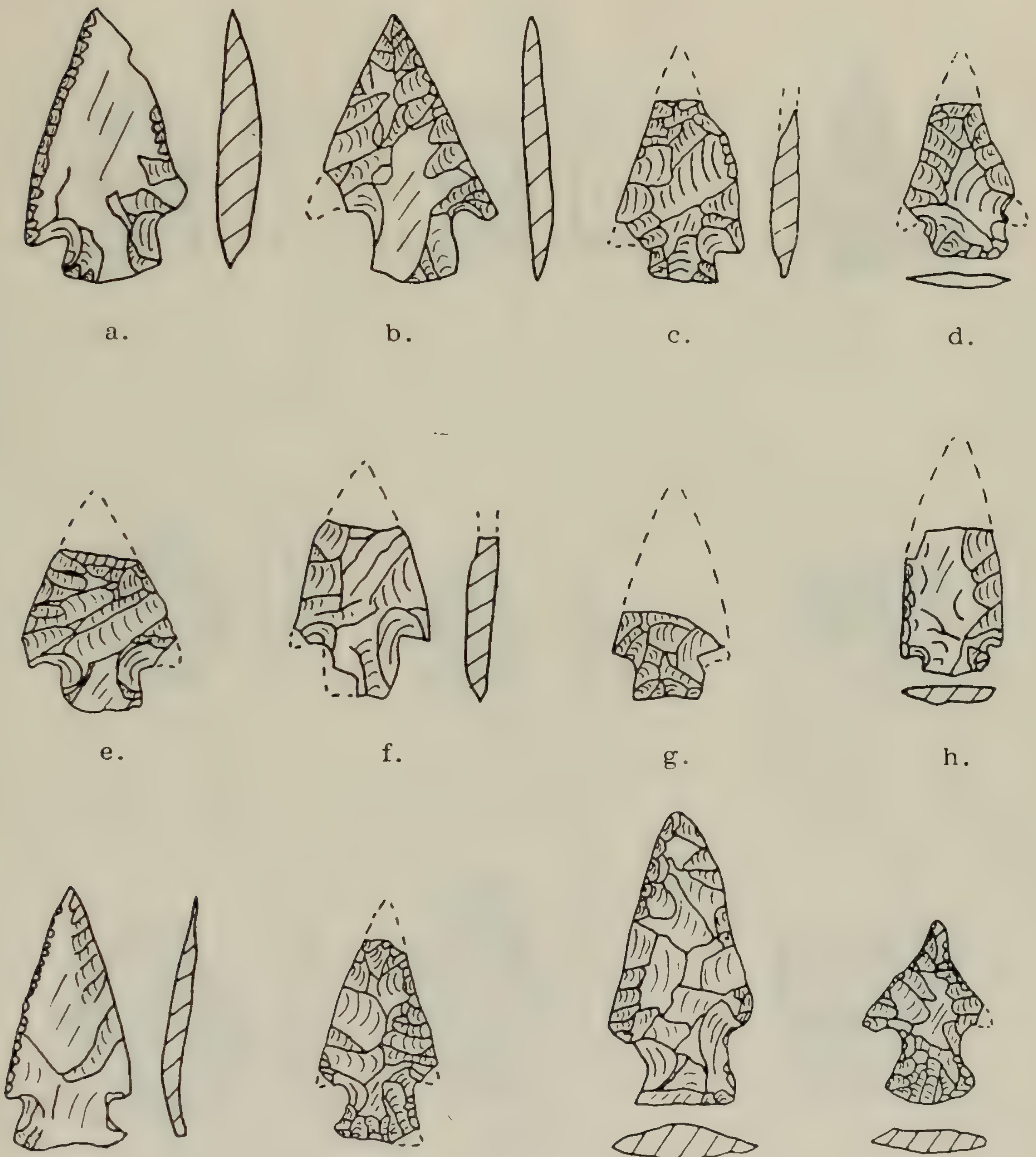
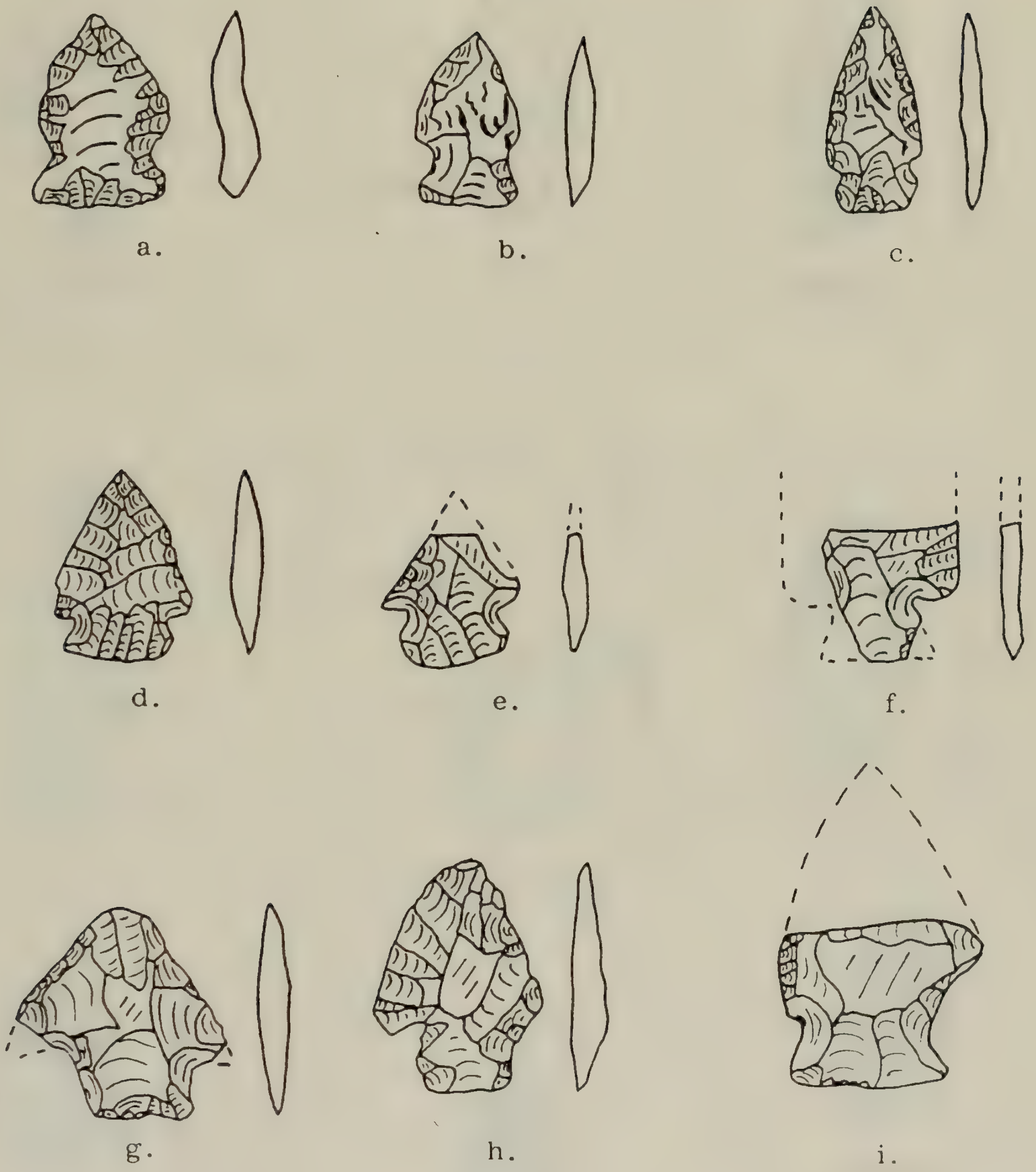


Figure 3.44
Projectile Points

a. LA 45483 b. LA 44889 c. LA 44889 #1
d. IO #94 e. LA 44892 f. LA 45467
g. LA 45467 h. LA 45451 i. LA 44876



a. b. c.

d. e. f.

g. h. i.

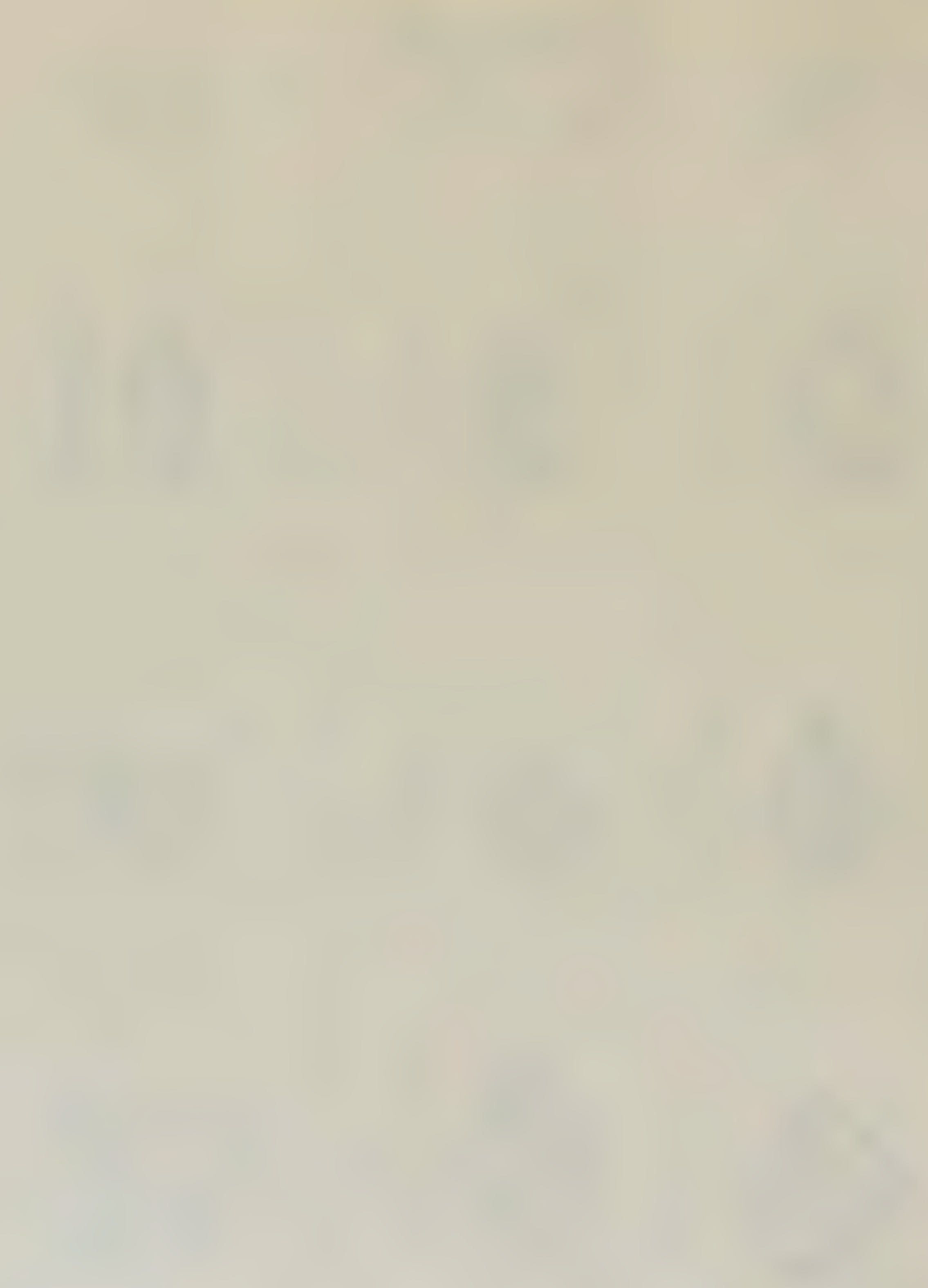
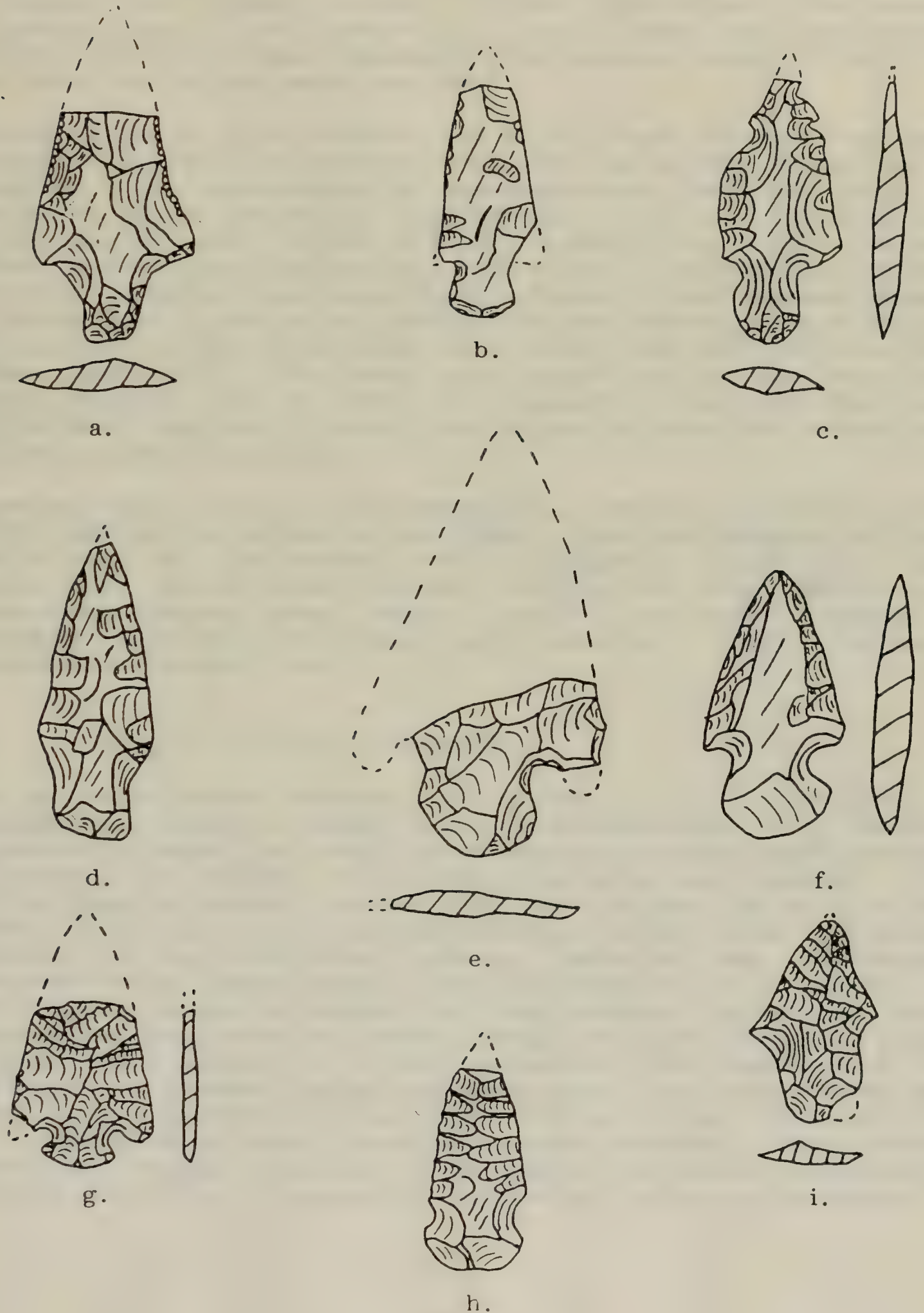


Figure 3.45
Projectile Points

a. IO #192
b. LA 2710
c. LA 44904
d. LA 45464
e. LA 44904
f. LA 45446
g. LA 45456
h. LA 44876 #21
i. LA 44896 #22



Five small points (Figure 3.46a-e) are characterized by triangular blades and corner notches creating straight to slightly expanding narrow stems. The notching ranges from broad to narrow. Two (Figure 3.46b,d) are similar to Leslie's Type 3D point and would be designated H12 or J12 points in Jelinek's (1967:94-97) system. Two others (Figure 3.46a,c) appear similar to Leslie's Type 3C points although they have short stems and would be designated J11 or possibly H11 in Jelinek's system. The fifth point (Figure 3.46e) is similar to Leslie's Type 3C and Jelinek's J12. All of these points are similar to ceramic horizon styles which apparently first appeared around AD 1000 - 1050 and lasted until slightly before AD 1200.

Figures 3.47 and 3.48 illustrate one of the most commonly represented projectile point style encountered during the Abo survey. These are small triangular points characterized by side-notches and bases that range from straight to slightly concave to deeply notched. They are considered similar to the Harrell, (e.g., Figure 3.47a-f), Scallorn (e.g., Figure 3.48e,f), Haskell (e.g., Figure 3.47g,h,i) and Washita (e.g., Figure 3.47l) style points of the late prehistoric and protohistoric affiliation. They represent examples of Leslie's Type 2 point series (1978:96-106) and include specimens identified as Types D25Y, D26Y, J25Y, J26Y, K25Y, K26Y, N25Y and O25Y in Jelinek's system (1967:94-97). The points characterized by the deep basal notch (Figure 3.47a-c) may be quite late, appearing after AD 1350 (Leslie 1978:96-106). One point (Figure 3.48a) appears to have been broken during the final stages of manufacture.

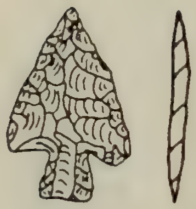
There are also a series of specimens that may represent completed projectile points, preforms for points, or point culls. These are illustrated in Figures 3.48i,k and 3.49. The majority would be included in Leslie's Type 1 series (1978:91-96). The specimens illustrated in Figure 3.48i,k may represent small substantially reduced biface knives. Most of the smaller specimens are considered indicative of the ceramic period occupation or protohistoric period occupation in the study area.

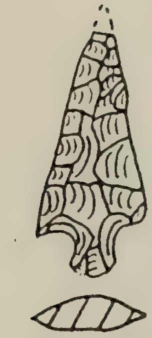
3.5 SUMMARY OF SURVEY RESULTS

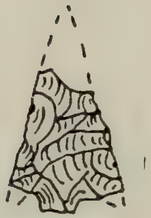
The Abo project survey resulted in the discovery of 121 archaeological sites (including one outside a sample unit) and re-examination of 15 previously recorded site locales (two could not be relocated and one was eliminated as too recent). In addition, 521 isolated occurrences were recorded. These cultural resources indicate that the study area has been the scene of human activity for at least 9,000 years and perhaps longer. Sites and artifacts indicative of the Paleoindian, Archaic, Formative, Late Prehistoric - Protohistoric and Historic periods are represented in the inventory. The most intense occupation appears to have occurred during the ceramic Formative and late prehistoric periods although occupation during the aceramic Archaic period appears to be well represented (see Table 3.20). The prehistoric site inventory includes a series of site types with a multitude of assemblage and locational configurations within each type. These site types are indicative of a broad range of activities including: lithic resource material procurement; a diversity of task specific tool use and limited activity workshop events (e.g., woodworking, butchering); short-term ephemeral

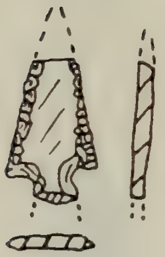
Figure 3.46
Projectile Points

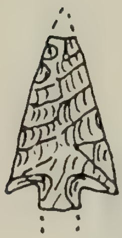
a. IO #127
b. LA 44896 #5
c. IO #271
d. LA 44879
e. LA 45474 #11
f. LA 37852


a.


b.


c.


d.


e.

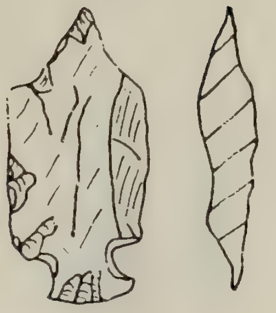

f.

Figure 3.47
Projectile Points

a.	IO #94	b.	IO #56	c.	IO #119
d.	LA 44889	e.	LA 44889 #34	f.	LA 44889 #36
g.	LA 44908 #20	h.	IO 6-27-7-8 extra	i.	LA 45447
j.	LA 44908 #3	k.	LA 44883	l.	LA 44908 #6

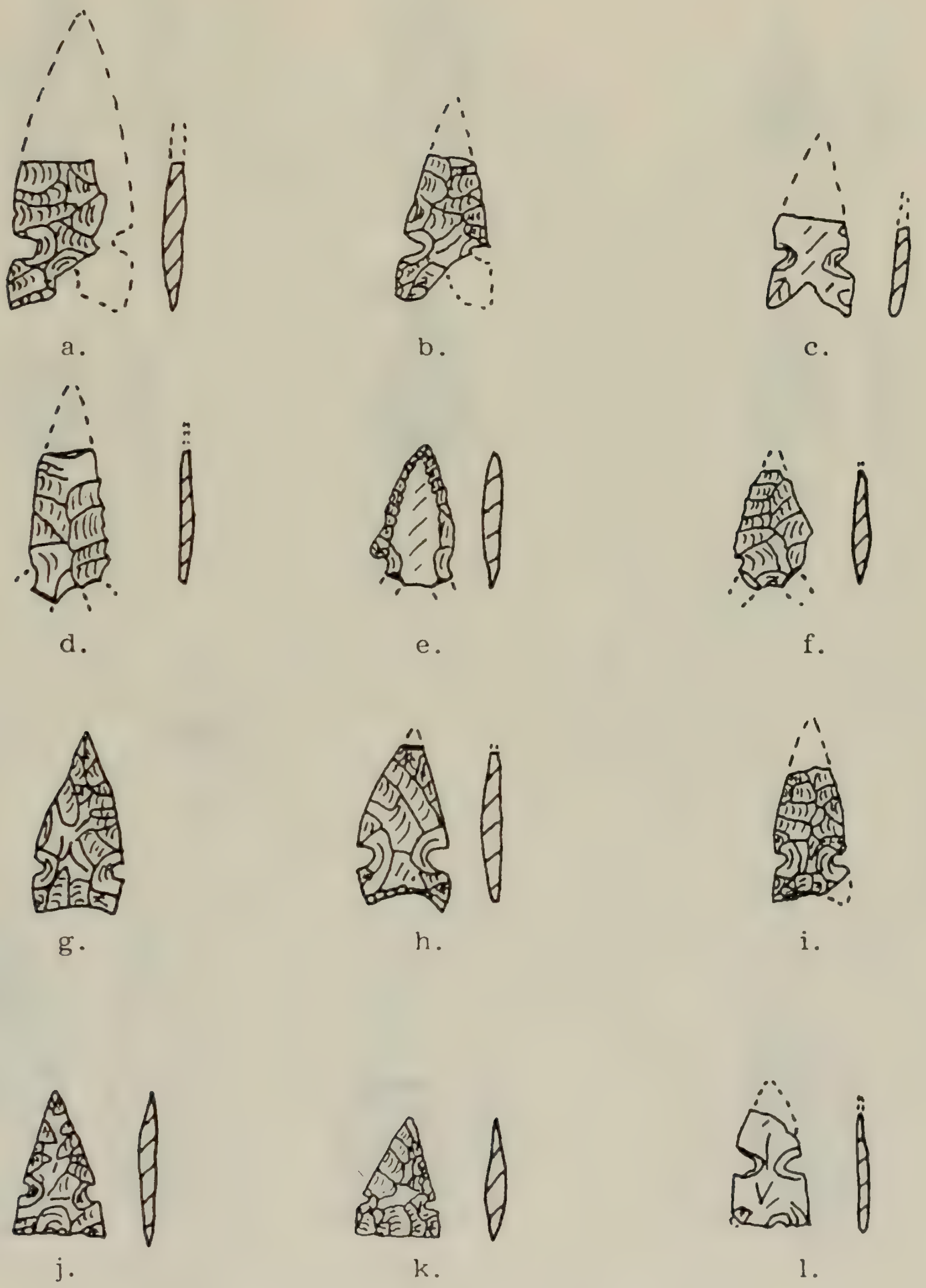

a. b. c. d. e. f. g. h. i. j. k. l.

Figure 3.48
Projectile Points

a. LA 44886 #3
b. IO #93
c. LA 44859 #9
d. LA 44887
e. LA 44897 #2
f. LA 44890
g. LA 44881
h. LA 44852
i. LA 44874 #2
j. LA 44889 #16
k. LA 44859

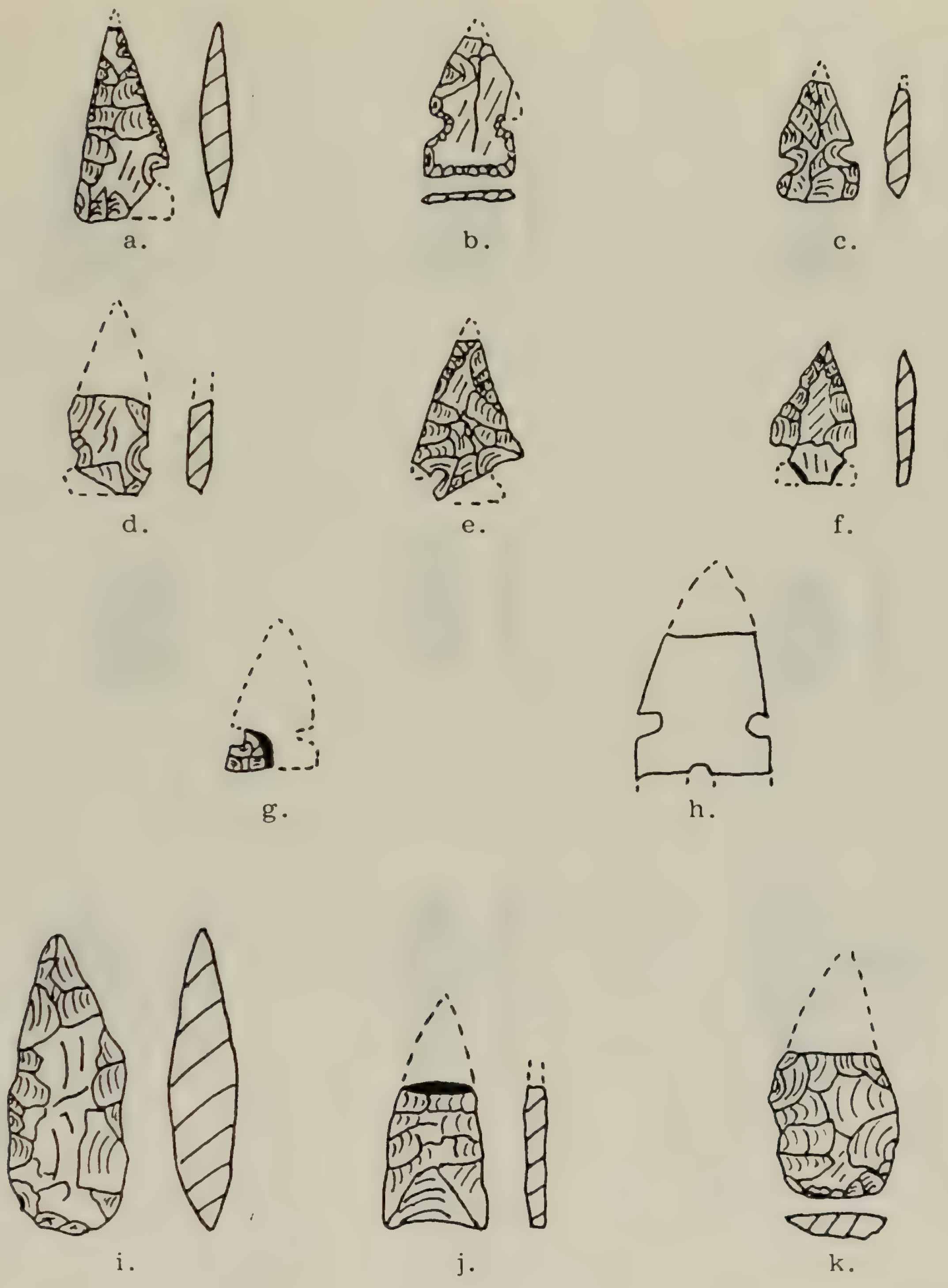
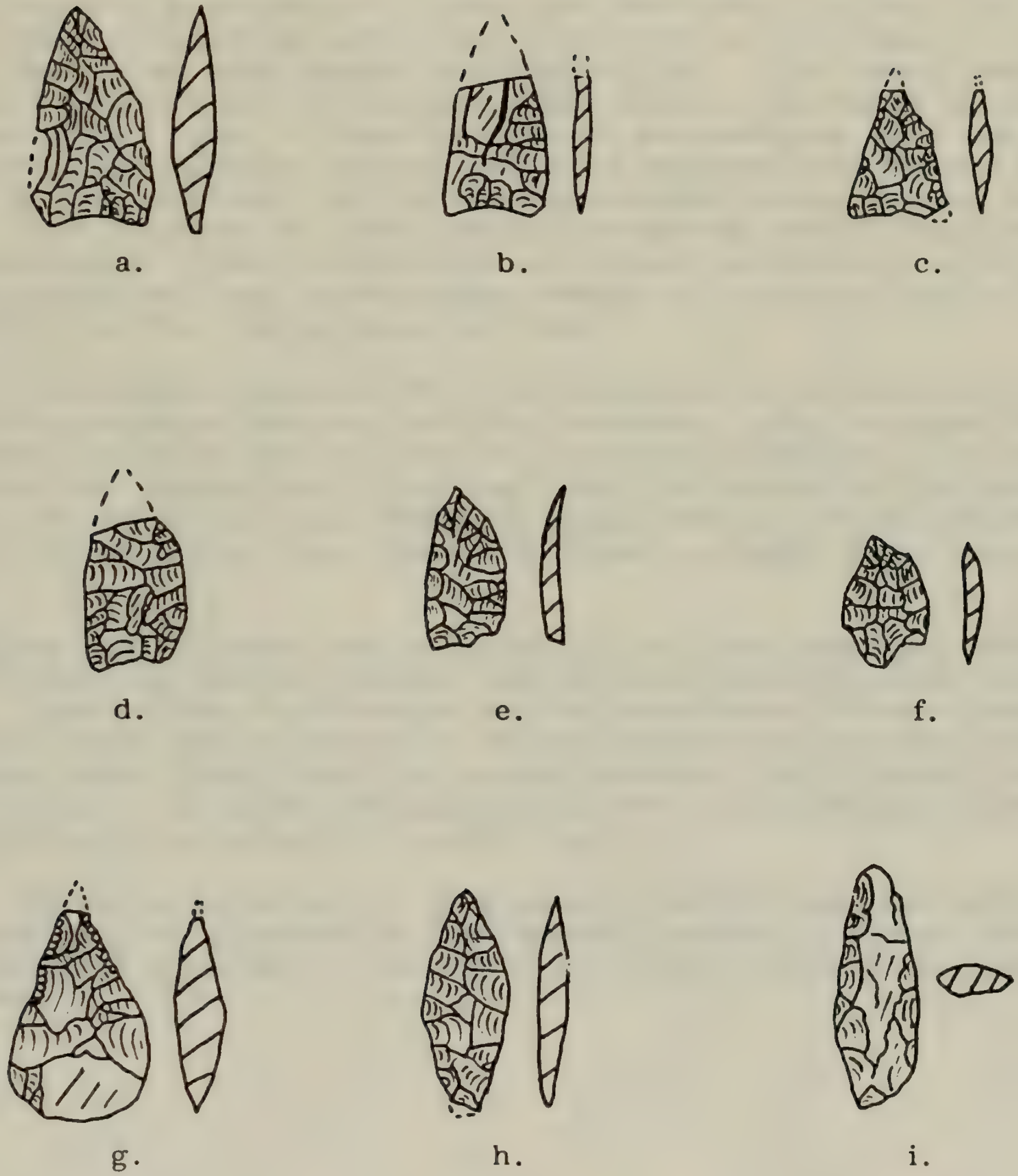


Figure 3.49
Projectile Points

a. LA 44883 b. LA 44908 #1 c. LA 45468 #57
d. LA 45447 e. LA 44908 #8 f. LA 45496
g. LA 44887 h. LA 45455 i. LA 44861 #1



camping; extended long-term camping; hunting; game processing; roasting; and seed milling. Although they are documented in the general vicinity (Jelinek 1967; Kelley 1966; Ross 1975), no evidence of settled villages or permanent communities was noted during the survey. Whether this is a product of sample bias or an indication of the intensity and patterning of sedentary settlement is currently undetermined.

The distribution of the sites encountered within the Abo study area is illustrated in Figures 3.50 and 3.51. Two measures were used to monitor the variability in the distribution of sites. The first uses the total number of sites as recorded as an index of density and distribution (Figure 3.50). The second method incorporates percentage of the total amount of space occupied by the sites within each sample unit (Figure 3.51). The second method is considered a useful tool for evaluating the relative occurrence of cultural resources across space. Since the size of archaeological sites can vary dramatically this alternative method provides a complimentary measure to the number of sites recorded. In this manner potential density skewing factors such as those generated by overly lumping or splitting cultural resources can be circumvented. That is, the amount of space occupied by a particular resource should not vary substantially whether it is recorded as one large multi-loci site or four smaller single loci sites.

Both site distribution figures (3.50, 3.51) illustrate the fact that the human use of the Abo project area was relatively extensive. Only two areas, one in the extreme northwest and the other in the southwest portions of the sample universe do not exhibit sites. This may simply be a result of the fortuitous placement of sample units and therefore sample error. This is particularly true for the southwest area where Salt Creek, a major water course, is present.

The density maps illustrate that while most of the study area was utilized in the past there are certain portions that received relatively more intensive usage. These include all the areas along the Pecos River; the area bordering Arroyo Del Macho; the area along the "break" between the Mescalero Pediment and Pecos River Valley; and the region northwest of Bitterlake National Wildlife Refuge. This latter area appears to have been particularly attractive to the prehistoric occupants of the study area.

Further information regarding the distribution of cultural resources within the Abo study area is presented in the following chapter. Various research topics potentially applicable to the Abo area cultural resources are presented in Chapter 5.

Figure 3.50
Distribution of Abo Project Sites by Sample Unit
(Circled values represent site frequencies)

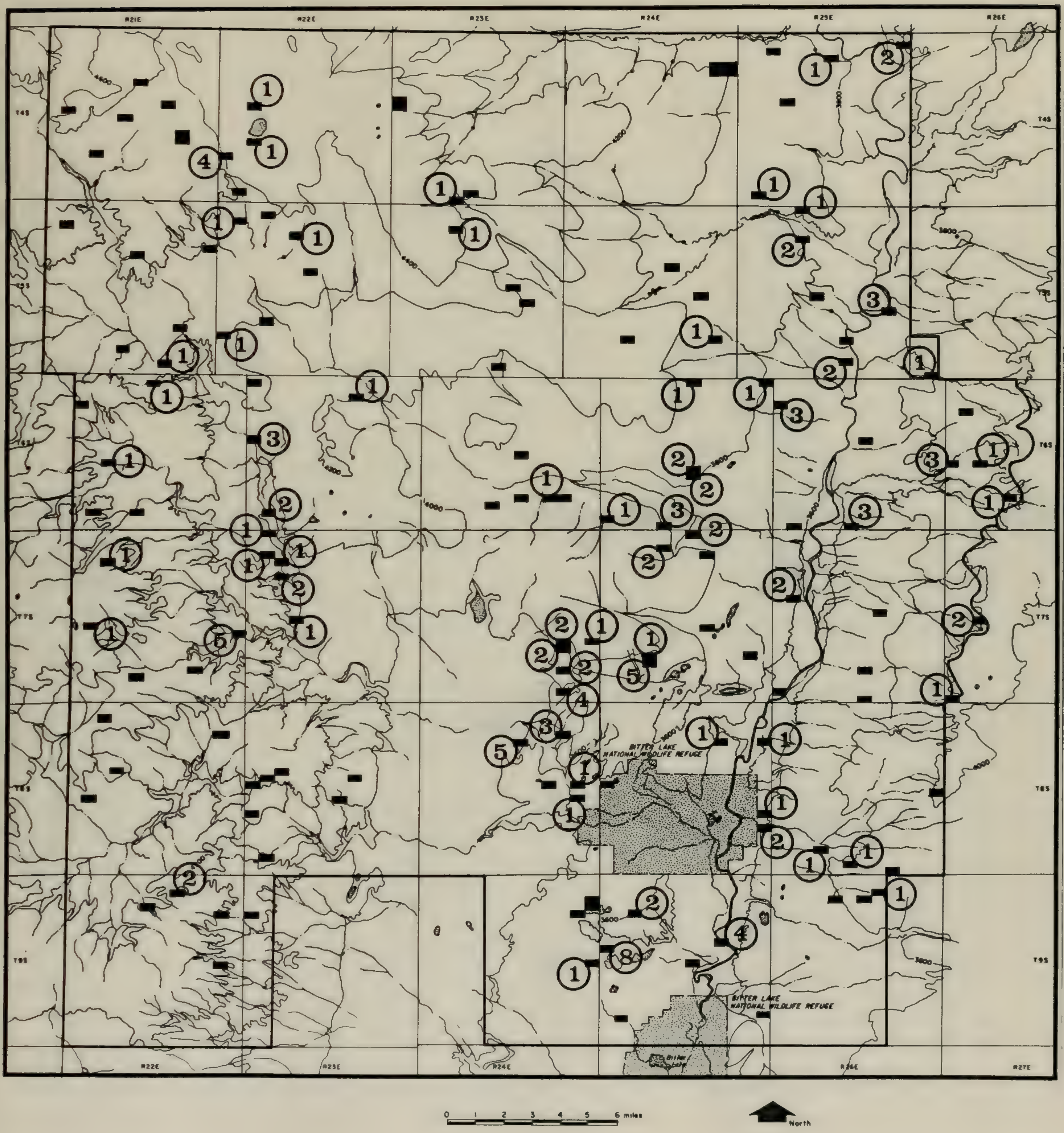
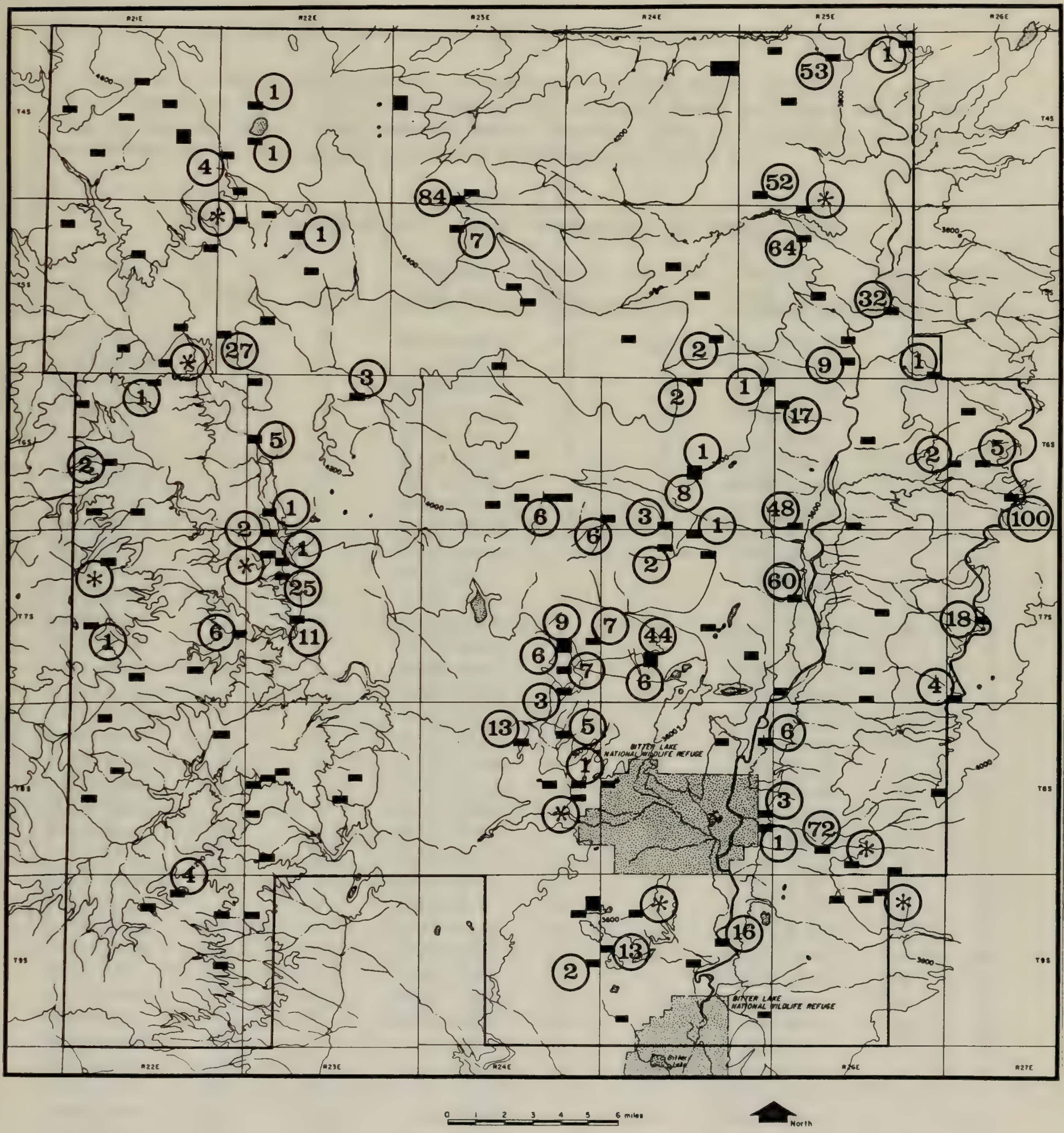


Figure 3.51
Percentage of Sample Unit Area Occupied by Abo Project Sites
(Numbers = percentage values; * = less than 1%)



Chapter 4

ANALYSIS OF SITE DISTRIBUTION AND LOCATION

4.1 DESCRIPTION AND ANALYSIS OF THE SAMPLE SURVEY DATA

A total of 134 sites, including 12 previously recorded sites, were found within the 150 sample units. Isolated cultural occurrences were numerous within the sample survey data; 514 isolates were found. The distributions of these resources among the sample units are presented in Table 4.1.

Table 4.1
Site and Isolated Occurrence Frequencies by Sample Unit

Survey Unit No.	No. of Sites	No. of IO's	Survey Unit No.	No. of Sites	No. of IO's	Survey Unit No.	No. of Sites	No. of IO's
4-22-20-7	1	7	4-22-30-3	4	14	4-22-31-5	2	3
4-23-18-3	0	2	4-23-18-6	0	4	4-25-3-7	1	5
4-25-27-4	0	2	5-21-6-8	0	2	5-21-10-7	0	0
5-21-12-5	0	2	5-21-26-4	0	5	5-21-33-1	0	1
5-21-36-6	1	4	5-22-5-4	0	3	5-22-6-5	1	2
5-22-9-1	1	12	5-22-16-3	0	12	5-22-29-1	0	8
5-22-30-6	1	3	5-23-4-7	1	3	5-25-4-2	1	14
6-22-4-8	1	5	6-22-7-6	0	1	6-22-20-6	1	0
6-22-31-4	0	2	6-22-33-3	0	0	6-23-6-7	1	2
6-23-31-4	2	7	7-22-19-4	1	5	7-22-8-2	1	11
7-22-24-5	5	2	7-23-6-1	1	3	7-23-6-8	1	1
7-23-8-2	1	2	4-25-4-1	2	5	5-25-24-6	3	0
5-26-31-8	1	5	6-26-15-7	0	4	6-26-33-8	0	2
6-27-7-8	0	2	6-27-19-6	3	7	6-27-20-6	1	3
6-27-28-7	1	0	7-22-26-7	0	0	7-22-33-2	0	1
7-23-8-6	2	3	7-23-20-1	1	7	7-26-15-8	0	3
7-26-27-7	0	0	7-26-34-7	0	1	7-27-20-2	2	1
7-23-31-7	1	0	8-22-5-6	0	3	8-22-12-2	0	3
8-22-17-4	0	2	8-23-15-4	0	0	8-23-17-3	0	2
8-23-18-5	0	1	8-23-18-7	0	3	8-23-19-7	0	3
8-23-31-4	0	2	8-23-22-3	0	12	8-25-12-4	1	0
8-26-24-1	0	1	9-22-3-5	2	4	9-22-9-1	0	1
9-22-12-3	0	0	9-22-24-2	0	2	9-23-7-3	0	0
8-26-32-1	1	1	9-25-31-1	1	0	9-26-4-7	0	3
9-26-3-5	1	1	9-26-3-7	0	4	9-24-1-8	1	6
9-24-12-1	0	7	9-24-12-3	0	1	9-25-8-3	2	6
9-25-22-2	0	0	9-24-24-1	1	3	9-25-18-6	8	6
9-25-14-3	5	3	9-25-24-8	1	2	8-25-25-4	2	7
8-24-13-7	1	1	8-24-14-7	0	0	8-25-18-7	0	3
8-24-24-3	1	2	8-26-33-5	1	1	9-25-25-8	0	0
8-26-35-7	0	1	7-24-23-8	2	6	7-24-24-8	1	8
7-24-26-1	2	1	7-24-26-8	2	5	7-24-35-5	4	7
7-25-3-2	2	7	7-25-3-8	0	1	7-25-4-6	2	7
7-25-22-4	0	4	7-25-29-4	1	8	7-25-29-5	5	6
8-24-10-3	5	3	8-24-11-1	3	4	6-25-33-7	3	7
8-25-11-3	1	2	6-24-22-3	0	3	6-24-33-2	0	5

Table 4.1 (continued)
Site and Isolated Occurrence Frequencies by Sample Unit

Survey Unit No.	No. of Sites	No. of IO's	Survey Unit No.	No. of Sites	No. of IO's	Survey Unit No.	No. of Sites	No. of IO's
6-25-22-7	2	11	6-25-27-2	2	3	6-26-31-8	2	1
7-26-18-4	2	7	7-26-31-6	0	0	4-24-12-1	0	4
4-24-12-2	0	2	4-24-12-3	0	4	4-24-12-4	0	2
4-25-31-5	1	9	4-23-33-5	0	12	4-23-33-7	1	2
4-25-5-6	0	5	5-23-14-7	0	0	5-23-23-4	0	6
5-23-34-5	0	0	5-24-18-1	0	3	5-24-23-1	0	1
5-24-25-6	1	5	5-24-28-6	0	4	5-25-9-2	2	0
5-25-21-1	0	0	5-25-27-5	0	7	5-25-34-4	2	6
6-23-10-4	0	1	6-23-18-7	3	2	6-24-26-7	1	0
6-24-26-8	0	2	6-24-27-7	0	1	6-25-1-1	1	4
6-25-3-2	1	8	6-25-31-7	1	0	6-26-7-6	3	9
7-25-25-7	0	0	4-21-10-7	0	3	4-21-14-6	0	6
4-21-18-8	0	0	4-21-21-1	0	0	4-21-23-5	0	2
4-21-23-8	0	3	4-21-29-4	0	2	4-22-17-6	1	3

The data from Table 4.1 are summarized into site and isolated occurrence frequency distributions in Table 4.2. As shown in Table 4.2, the site frequency distribution is highly skewed, for approximately half (50.7%) of the sample units did not contain any sites. Isolates also exhibit a skewed distribution, but not nearly as pronounced as the site frequency array.

A simple average of the data indicates that site density is 0.893 sites per sample unit and 3.427 isolated occurrences per unit. Since the sample was stratified into groups of four township-range units a series of analyses were conducted to assess the statistical characteristics of the sample. The average of the grouped means is very close to that of the simple average; 0.843 sites and 3.356 isolates per sample unit. Difference of Means tests were performed to assess whether the cultural resource variability differed significantly between the eight township-range sampling strata, i.e. to test whether the eight means represent the same or different (sub)populations of site densities within the Abo study area (cf. Croxton 1953:235-242). The tests, measured by the t statistic, indicated that there were no significant differences among the means and therefore the stratified samples represent observations from the same sample population of site and isolate densities.

Although the stratified samples cohere together within the same sample population this does not necessarily mean that the Abo sample has adequately measured the density variability for the cultural resources population contained within the entire Abo study area. Definition of sample adequacy utilized here follows Cochran (1977), where the sample data must estimate the size of the entire Abo population with a specified level of confidence and tolerable error of estimate. If the sample meets these adequacy requirements, then the standard error will be accurate and site frequency and density estimate ranges will also be accurate. If the sample survey was not adequate, then the standard error will not be accurately measured and the density ranges will be underestimated by an unknown amount. In order to

Table 4.2
Cultural Resources Frequency Distributions
within the Abo Sample Units

Frequency Class	No. Sample Units with Sites	(%)	No. Sample Units with Isolates	(%)	No. Sample Units with Sites and Isolates	(%)
0	76	(50.7)	25	(16.7)	17	(11.3)
1	42	(28.0)	21	(14.0)	20	(13.3)
2	19	(12.7)	25	(16.7)	20	(13.3)
3	6	(4.0)	23	(15.3)	21	(14.0)
4	2	(1.3)	11	(7.3)	12	(8.0)
5	4	(2.7)	10	(6.7)	8	(5.3)
6	0	(0)	9	(5.0)	8	(5.3)
7	0	(0)	12	(8.0)	7	(4.7)
8	1	(0.7)	4	(2.7)	6	(4.0)
9	0	(0)	2	(1.3)	7	(4.7)
10	0	(0)	0	(0)	3	(2.0)
11	0	(0)	2	(1.3)	2	(1.3)
12	0	(0)	4	(2.7)	5	(3.3)
13	0	(0)	0	(0)	2	(1.3)
14	0	(0)	2	(1.3)	1	(0.7)
15	0	(0)	0	(0)	1	(0.7)
16	0	(0)	0	(0)	0	(0)
17	0	(0)	0	(0)	0	(0)
18	0	(0)	0	(0)	1	(0.7)

assess the adequacy of the sample, the Abo survey data were analytically treated as a pilot sample. Whether or not the 150 sample units surveyed are adequate to measure site frequencies and densities is measured by:

$$N_o = \frac{t^2 N^2 S^2}{d^2}$$

Where: N_o = number of sample units (observations) required

t^2 = normal deviate at the level of confidence desired (set at 95% for the Abo area; t = 1.96)

N^2 = total number of 80 acre sample units in the Abo sample area (7,951)

S^2 = variance exhibited in the Abo sample data (0.100)

d^2 = acceptable error (355 sites, representing 5% of the 7,100 sites estimated to be present in the Abo area based on the sample survey).

In this case, the number of sample units required to estimate frequency and density variation at the 95% level of confidence in the Abo study area is:

$$N_o = \frac{(1.96)^2\ (7951)^2\ (0.10)}{(355)^2} = 193$$

Therefore, at least 193 sample units must be surveyed to adequately estimate site frequencies and densities at the 95% level of confidence. This formula assumes that the sample data frequencies are normally distributed. However, as shown in Table 4.2, the site frequency distribution is highly skewed. Under such circumstances, it is essential to examine a sufficiently large sample to ensure that the results obtained in the Abo sample survey were in fact representative of the cultural resources density and frequency variation within the Abo area. Cochran (1977) utilized the following "rule of thumb" formula for estimating the minimum number of samples necessary to obtain precise estimates of error. This estimating equation takes skewness within the pilot sample into account and is expressed as:

$$N_r \geq N_p\ G^2;$$

Where: N_r = number of samples required for precise estimation of error

N_p = number of units in the pilot sample

G^2 = Fisher's measure of skewness

For the Abo case,

$$n_r \geq 150(4.277) = 642 \text{ sample units}$$

Therefore at least 642 sample units or 8% of the Abo study area must be sampled to achieve precise estimates of site frequency and density variation. This means that another 492 sample units must be surveyed to estimate site density variation with precision, and the 150 units surveyed by the Abo Class II effort achieved approximately 23% of the requisite amount for this area. Based on the Abo sample data it can be stated that site densities range between at least 0 - 8 sites per 80-acre sample unit, and the number of sites within the sample area (extrapolated from the sample mean of 0.893 sites/sample unit) is 7,100 sites, although the precision of this estimate cannot be stated with any degree of confidence. Given these results, the data analyses presented in the previous chapter and those which follow must be considered first approximation studies only, for considerable amount of additional sample survey is required to ensure representativeness and precise estimates.

An analysis of the relationship between sites and isolated occurrences was conducted to assess the potential for predicting site occurrence using nonsite (i.e., isolates) data. A Pearson's r correlation coefficient value of 0.280 was obtained from the comparison of site and isolated occurrence frequencies. This coefficient value shows a weak, but nonetheless significant ($p \leq .01$; see Young and Veldmann 1965:420) positive relationship between these two variables.

Based on this finding, another set of analyses were conducted to identify which of the two variables was the stronger predictor. That is, are isolated occurrence frequencies more sensitive predictors of site incidence, or are site frequencies more sensitive predictors of isolates? To resolve this question, two frequency distributions were prepared and are shown in Table 4.3. The first of these shows the distribution of site frequencies within those sample units that contain isolates. The percentages associated with this distribution were calculated on the basis of the total number of sample units within each frequency class shown in Table 4.2. For example, Table 4.3 shows that 55 sample units lacking sites (frequency = 0) contained one or more isolated cultural occurrences. As shown in Table 4.2, the total number of sample units containing no sites is 76. Thus 72.3% of the sample units lacking sites contain isolates. Table 4.3 shows that sample units containing sites are highly likely to contain isolates. This relationship is strong. As site frequencies increase, the co-occurrence of isolates quickly reaches 100%.

Table 4.3
Frequency Distributions Showing the Co-occurrence of
Sites and Isolates in the Abo Sample Data

Frequency Class	Sites/Unit with Isolates Present	(%)	Isolates/Unit with Sites Present	(%)
0	55	(72.3)	9	(36.0)
1	37	(88.1)	8	(38.1)
2	18	(94.7)	9	(36.0)
3	5	(83.3)	11	(47.8)
4	2	(100.0)	4	(36.3)
5	4	(100.0)	7	(70.0)
6	0	-	6	(66.7)
7	0	-	10	(83.0)
8	1	(100.0)	3	(75.0)
9	0	-	2	(100.0)
10	0	-	0	-
11	0	-	2	(100.0)
12	0	-	1	(25.0)
13	0	-	0	-
14	0	-	2	(100.0)

The converse of this relationship, however, is not nearly as strong. For this analysis, the distribution of isolated occurrence frequencies within those sample units containing sites is also presented in Table 4.3. As shown in the table, at least nine isolates must occur in a sample unit before the odds that a site will also occur reaches 100%. Therefore it appears that sites are stronger predictors of isolates than vice versa. This is perhaps unfortunate in terms of potential management applications of this relationship, but nonetheless, these data may indicate some important facts regarding prehistoric land use patterns and problems in resource detection in the Abo region.

There is evidence to demonstrate that cultural resources are differentially detectable within the Abo study area. During the course of survey, the two crews working in immediately adjacent areas showing similar environmental settings would frequently generate entirely different inventory results. Since comparability in survey data between the two crews was an important objective, attention was paid to identifying the cause(s) of inventory discrepancies. The principal causal agency for differential cultural resources detection that was discovered during the Abo survey was differential erosion. It was found that areas exhibiting little aeolian or alluvial erosion activity, usually in settings with relatively uniform, dense grass cover and moderately well developed soils, rarely exhibited isolated occurrences and even more rarely, sites. In contrast, settings which were pedologically and vegetatively similar but showed evidence of wind and water erosion, were those in which isolates and a substantially higher incidence of sites were found. Cultural resources, moreover, were generally manifested within the erosion zones, including cattle trails and road cuts. The differential incidence of cultural resources between sample units occurred throughout the area, but were encountered most frequently in the northwest quadrant of the Abo study area. Given these observations, it is virtually certain that buried sites exist throughout this region and conventional survey techniques alone are not sufficient to ensure that all significant resources threatened by ground disturbing activities related to oil and gas development will be found and protected.

There is also evidence to show that the differential occurrence of sites and isolates are the outcomes of prehistoric land use patterns. The crews noted relatively numerous settings where the ground surface was denuded or stabilized and where the preserved outcomes of past human activities were virtually completely visible. Examples include gravel terraces adjacent to major drainages and the limestone hill country where soils are often shallow or absent in the western portion of the study area. In such settings, the survey crews could conclusively show that there were instances where the intensity of prehistoric land use was low and sites were, in fact, rare.

4.2 SITE LOCATIONAL MODEL REFINEMENT

The Abo sample survey fieldwork (Phase II) was instrumental in refining and adding more appropriate site location variables for use in modeling. Three major revisions in the variables were made.

First, the on-the-ground survey experience provided valuable information for differentiating the relative reliability of water supplies. The Phase I method of measuring the distance from a site to the nearest blue line on the topographic map was not considered to be a satisfactory approach to the intended purpose of this variable, i.e. to measure variability in spatial association between sites and water, a critical and valuable resource. Given the fact that twentieth century land use practices had substantially reduced water availability, it was not possible in the absence of fieldwork experience to distinguish ephemeral from more reliable water supplies that would have likely been available in the prehistoric and early historic past. During the fieldwork phase, it was noted that drainages which probably influenced site location due to water availability were those which were well developed and had significantly altered the surrounding landscape into relatively large catchments. Those intermittently flowing drainages which exhibited short water courses, drained small catchment areas and were less topographically developed were often found to be very recent outcomes of erosion or would constitute extremely ephemeral water supplies. Sites, moreover, were invariably absent from such loci. As a consequence of this information, the distance to water variable was revised and is defined as the distance in meters from the periphery of a site to the nearest playa, sink, spring lakebed, or topographically well developed drainage.

The revision in the distance to water variable caused a change in the measurement of a related variable - drainage rank. Drainage rank was changed from the rank of the nearest blue line to the rank of the water source used in measuring distance to water. This revision eliminated a number of problems noted in the Phase I model development activities. Those instances where sites were located near small ephemeral drainages entered the Pecos River were previously ranked as equivalents to major tributaries of the Pecos such as Salt Creek. Under the revised system, such cases were assigned the rank value of the nearest reliable water supply and thus eliminated skewing of drainage significance.

Another variable was added to the locational data - elevation. Site elevation was measured in feet above mean sea level and was collected from the USGS topographic maps. It appeared likely that elevation would prove to be an important variable that would tend to segregate the various site locational settings into geographically meaningful zones within the Abo study area. The area tends to dip to the east with the lowest elevations along the Pecos and the highest in the limestone hill country in the westernmost portion of the study area (see Figure 1.2). Little or no geographic contiguity was noted for the Phase I site location models, for each model contained sites from loci scattered throughout the project area.

In all, eight locational variables were monitored. Those which are described in Chapter 2.2 of this report include elevation advantage, local relief, view angle, slope and aspect. The revised variables include distance to water, drainage rank and elevation. As will be subsequently demonstrated, the revised set of variables proved to be important regulators of site location.

Model refinement began with a series of cluster analyses using the Abo sample survey data. The Statistical Analysis System (SAS) software package

FASTCLUS routine, identical to that previously described in Chapter 2.2, was used. Clustering was performed on the site location variables monitored for each site. The values were coded and compiled into a computerized data file. Four sets of analyses were conducted with the number of clusters set at 40, 20, 10 and 4 respectively. The purpose of these analyses was twofold. First, the series of cluster analyses would provide a first approximation assessment regarding the most appropriate site setting diversity range within the Abo study area. Second, the cluster analyses provided an initial assessment of the relative importance of the locational variables used to characterize and differentiate the various site settings described by the clusters.

The distribution of site frequencies within the four sets of clusters is presented in Table 4.4. As shown in this table, as the number of clusters decrease, the site frequencies become increasingly nonrandomly distributed among each set of clusters. These data indicate that as the acceptable range of variability increases within each cluster, i.e., the site setting characteristics become increasingly generalized, site locational preference patterns emerge. Based on this information, it would appear that the 40-cluster set represents an overly refined characterization of site settings which has masked real patterns in differential site location preference.

This conclusion is further supported by additional evidence. The cluster analyses also provided a preliminary indication as to the relative importance of the variables in discerning site location patterns. This is expressed in terms of R^2 values which measures the correlational strength between the range of values for each variable (y), for each cluster (x), and thus the set of clusters is treated as grouped data. Basically, the higher the R^2 values (where 1.00 is a perfect association and 0.0 is a perfectly random association), the narrower and more distinctively different the range of variation is for each cluster. In other words, R^2 values increase directly with the importance of the role that each variable plays in differentiating site settings manifested in the data. A comparison of these R^2 values for all variables within each set of clusters is presented in Table 4.5.

Table 4.5 illustrates a number of important facts. First, the table demonstrates the effects of "lumping" as the number of clusters decrease and the characterization of site settings become increasingly generalized. Because the range in variation increases, there is an increasing incidence of overlapping values between clusters. Thus the R^2 values decrease as the number of clusters decrease. Based on the information in Table 4.5, it would appear that the four-cluster set is overly generalized, for the R^2 values are substantially lower than those for the other clusters. Second, the R^2 values specify the relative importance of each variable in characterizing and differentiating site locational settings defined by the clusters. Table 4.5 shows that in all sets of clusters, distance to water is the most important variable that distinguishes the clusters from one another. From this perspective, there is additional evidence that the four-cluster set is overly generalized, for the R^2 values for the remaining variables are extremely low. The remaining three sets of clusters mutually agree that elevation and drainage rank also play an important role in distinguishing and defining site locational settings.

Table 4.4
Distribution of Site Frequencies Within the Four Sets of Clusters

Cluster Number	No. of Sites	No. of Sites	No. of Sites	No. of Sites
1	1	1	22	1
2	5	2	36	46
3	2	3	2	62
4	2	1	2	17
5	2	6	21	
6	2	12	5	
7	1	6	8	
8	9	5	1	
9	2	7	5	
10	5	3	24	
11	1	3		
12	1	3		
13	4	6		
14	9	20		
15	7	15		
16	1	9		
17	2	6		
18	1	11		
19	6	5		
20	2	2		
21	1			
22	2			
23	4			
24	6			
25	1			
26	4			
27	2			
28	1			
29	2			
30	7			
31	2			
32	1			
33	3			
34	2			
35	3			
36	2			
37	5			
38	8			
39	4			
40	1			

Table 4.5

Comparison of R^2 Values for the Variables Used in the Cluster Analyses

Variable	40-Cluster R-Squares	20-Cluster R-Squares	10-Cluster R-Squares	4-Cluster R-Squares
Dist. to Water	.995	.981	.965	.883
Elevation	.962	.927	.774	.133
Aspect	.783	.483	.146	.042
Drainage Rank	.779	.627	.389	.135
View Angle	.698	.397	.163	.129
Elev. Advantage	.530	.203	.074	.007
Local Relief	.469	.179	.115	.036
Slope	.363	.112	.099	.080

Given this information it would appear that the most appropriate number of site settings to be modeled for the Abo area falls between 10 and 20. The 40-cluster set is too refined and masks site frequency patterning. The four-cluster set is too generalized, for it is statistically weak and masks the multivariate nature of site locational patterning. Based on these findings, subsequent analyses were confined to the 10 and the 20 clustered sets of data.

The two data sets were subjected to stepwise discriminant function analysis. As described in Chapter 2.2, in discriminant analysis, the variables which appear to differentiate the clusters from one another are combined into a multivariate equation and weighted to minimize within-cluster variation and maximize between-cluster variation. Thus each cluster is forced to be as mathematically distinct from the others as possible. In the stepwise procedure, the SAS program STEPDISC was instructed to find, in the order of relative importance, the variables which best distinguish between clusters.

Two statistical measures, the f-ratio and Wilk's Lambda were used by the program to describe and rank those variables which contribute significantly to between-group variation. The level of confidence was set at $p \geq 0.15$ (i.e., the odds that between-group variation exceeds within-group variability is at least 85% certain). The outcomes of the stepwise discriminant analyses for the 10-cluster and the 20-cluster data sets are presented in Table 4.6. As shown in this table, neither analysis accepted all eight variables to be significant. In the 10-cluster set, local relief did not contribute significantly to cluster distinctiveness, and in the 20-cluster set two variables, local relief and slope, failed to distinguish the clusters from each other. As initially indicated in the cluster analyses, distance to water and elevation, in that order, are two extremely important variables for distinguishing site settings for both sets of clusters. Although there are discrepancies in rankings for the remaining variables, both agree that drainage rank and aspect are more important than view angle and elevation advantage in distinguishing between clusters.

Table 4.6
Stepwise Discriminant Function Analysis Summaries for the 10 and 20 Clustered Site Data

10-Cluster Data Set

Step	Variable	F-Ratio	Prob. > F	Prob. > Lambda
1	Distance to Water	359.48	0.0001	0.0001
2	Elevation	43.78	0.0001	0.0001
3	Drainage Rank	4.82	0.0001	0.0001
4	Aspect	2.20	0.0270	0.0001
5	View Angle	1.70	0.0966	0.0001
6	Slope	1.59	0.1251	0.0001
7	Elevation Advantage	1.56	0.1359	0.0001

20-Cluster Data Set

Step	Variable	F-Ratio	Prob. > F	Prob. > Lambda
1	Distance to Water	283.20	0.0001	0.0001
2	Elevation	71.43	0.0001	0.0001
3	Aspect	5.05	0.0001	0.0001
4	Drainage Rank	4.22	0.0001	0.0001
5	View Angle	2.22	0.0057	0.0001
6	Elevation Advantage	1.65	0.0576	0.0001

These two sets of data were then examined using another discriminant analysis program (the SAS DISCRIM routine). This program developed a formal location model in the form of a weighted polynomial equation for each cluster and tested the strength of the models by assessing the accuracy with which sites were classified into their appropriate clusters. One cluster (cluster No. 8 in Table 4.4) was eliminated from modeling from the 10-cluster set since it contained only one site. For the same reason, two clusters (cluster Nos. 1 and 4 in Table 4.4) were eliminated from modeling in the 20-cluster set. In the reclassification tests, the site locational data were monitored on a site-by-site basis by each of the discriminant functions. Each site was then classified into a group in terms of goodness of fit to a particular site location model. This test is designed to assess how distinct the models are from each other and also to determine how well each model performs in "recognizing" members of its group. The results of the reclassification tests are presented in Table 4.7. This table shows that both sets of models were highly successful in recognizing its members and thus represent distinctively different and recognizable site settings.

Table 4.7
Reclassification Analysis of the Site-Specific Location
Data for the 10-Cluster and the 20-Cluster Data Sets

Cluster Number	No. Sites in Cluster	No. Sites Correctly Classified	(%)
1	22	22	(100)
2	36	35	(97)
3	2	2	(100)
4	2	2	(100)
5	21	21	(100)
6	5	5	(100)
7	8	8	(100)
8	1	N/A	N/A
9	5	5	(100)
10	24	24	(100)
TOTAL	126	125	(99)

Cluster Number	No. Sites in Cluster	No. Sites Correctly Classified	(%)
1	1	N/A	N/A
2	2	2	(100)
3	3	2	(100)
4	1	N/A	N/A
5	6	4	(67)
6	12	12	(100)
7	6	5	(83)
8	5	5	(100)
9	7	7	(100)
10	3	3	(100)
11	3	3	(100)
12	3	3	(100)
13	6	6	(100)
14	20	20	(100)
15	15	15	(100)
16	9	8	(89)
17	6	6	(100)
18	11	11	(100)
19	5	5	(100)
20	2	2	(100)
TOTAL	126	123	(98)

Given the results of the analyses, it would appear that both sets of models represent good first approximations of the kinds of site settings that exist within the Abo study area. Comparisons with the Phase I models, moreover, indicate that these are stronger. In their reclassification analysis, Kemrer and Kearns (1982:55) obtained approximately 90% correct classification. The rate of correct classification with the Abo sample survey data is 8 to 9% higher. This difference in strength may be attributable to one of two factors; either 1) the new variable, elevation, combined with the revised methods of measuring distance to water and drainage rank (all of which are significant) has improved the characterization of site setting, or 2) the range of variability in site location attributes is greater in the previously recorded site data used in the Phase I effort and thus are more difficult to characterize (or model) than the Abo sample survey site data. In order to address these alternatives and to evaluate whether or not the models required revision, another data base was created. All previously recorded sites located within the Abo study area were coded vis-a-vis the eight location variables and compiled into a computerized data file. The first analysis performed was to pass all of the previously recorded site data through the 10

and 20 cluster models developed from the Abo sample survey data. The purpose of this analysis was to evaluate how well the models "recognized" site locations and with what degree of probability based on an entirely different set of observations. The results of this analysis are presented in Table 4.8. This table shows the distribution of site frequencies within probability value range classes. The (re)classification routine basically takes the values for the eight variables for each site and passes these values through each of the previously developed discriminant function equations (the 10-cluster set and the 20-cluster set) and calculates the exact probability with which each site "fits" a particular equation. The probability classes shown in Table 4.8 represent the highest (i.e., maximum) probability score that each site achieved when passed through the equations. As demonstrated in this table, the majority of the previously recorded sites exhibit probabilities of association with a particular equation (model) at levels at or exceeding 90% for both sets of models. It is therefore clear that the majority of the previously recorded sites share highly similar locational settings with the sites recorded in the Abo sample survey.

Table 4.8 also shows that the previously recorded sites achieved higher probability scores with the 10-cluster models than the 20-cluster set of equations. This is due to the fact that the locational values for each site had a greater number of opportunities to "fit" with more than one model in the 20-cluster set. And, because the 20-cluster models collectively represent a less generalized set of site settings, the differences between them is more subtle than the 10-cluster set. Thus the frequency with which a given site was assigned a probability of association value for more than one model was significantly higher for the 20-cluster set.

Table 4.8
Distributions of Classified Previously Recorded Site
Locations within Maximum Probability Classes

Probability Range	10-Cluster Models Site Frequency	(%)	20-Cluster Models Site Frequency	(%)
.30 - .34	0	(0)	0	(0)
.35 - .39	0	(0)	1	(0.4)
.40 - .44	1	(0.4)	3	(1.4)
.45 - .49	0	(0)	2	(0.9)
.50 - .54	5	(2.3)	10	(4.6)
.55 - .59	10	(4.6)	11	(5.1)
.60 - .64	7	(3.2)	4	(1.9)
.65 - .69	4	(1.9)	7	(3.2)
.70 - .74	4	(1.9)	10	(4.6)
.75 - .79	10	(4.6)	9	(4.2)
.80 - .84	7	(3.2)	17	(7.9)
.85 - .89	9	(4.2)	18	(8.3)
.90 - .94	9	(4.2)	26	(12.0)
.95 - 1.00	150	(69.4)	98	(45.4)

Both frequency arrays in Table 4.8 do indicate, however, that there may be some variability in the previously recorded site locations that are not adequately accounted for in the models developed from the Abo sample survey data. This is not surprising, given the evidence that the sample survey did not capture the full range of cultural/temporal and site type variation that is known to exist within the study area (see Chapter 3). Similarly there are statistically documented reasons to believe that the Abo sample survey was insufficient to estimate with reliable precision site frequencies and densities within the study area (see Chapter 4.1). Since the goal of the modeling effort is to develop the most refined models possible, the Abo survey and the previously recorded site data files were combined and the models were re-derived. The cluster analyses were again performed with the number of clusters permitted set at 10 and 20. The two sets of clusters were then subjected to stepwise discriminant function analysis. The results of this analysis are presented in Table 4.9.

Table 4.9
Stepwise Discriminant Analysis Summaries for the 10 and 20 Clustered Sample Survey and Previously Recorded Site Data

10-Cluster Data Set

Step	Variable	F-Ratio	Prob. > F	Prob. > Lambda
1	Distance to Water	1007.48	0.0001	0.0001
2	Elevation	65.21	0.0001	0.0001
3	Drainage Rank	3.74	0.0002	0.0001
4	Slope	2.21	0.0210	0.0001

20-Cluster Data Set

Step	Variable	F-Ratio	Prob. > F	Prob. > Lambda
1	Distance to Water	884.90	0.0001	0.0001
2	Elevation	55.08	0.0001	0.0001
3	Aspect	7.44	0.0001	0.0001
4	Drainage Rank	3.11	0.0001	0.0001
5	View Angle	2.43	0.0009	0.0001
6	Elevation Advantage	2.12	0.0046	0.0001
7	Local Relief	1.66	0.0421	0.0001

A comparison of this table with the results of the previous stepwise analysis (Table 4.6) show a number of similarities and differences. First, all analyses show that distance to water and elevation are the two most important variables in differentiating site settings. For the 10-cluster set, distance to water, elevation and drainage rank are the three most significant variables in both sets of models. The number of variables which significantly differentiate the various site settings, however, is reduced from seven to four in the 10-cluster set derived from all available site data. The reason for this

reduction in significant variables can be seen in the two tables. The f-ratio values which quantify the between-cluster:within-cluster variance are substantially higher for the distance to water and elevation in Table 4.9. This indicates that these two variables now play much stronger roles in differentiating site locations, and the remaining six variables are delegated roles of lesser importance. In fact only two of these six, drainage rank and slope, contribute significantly to site setting characterization.

The two 20-cluster sets also differ in terms of the number and relative importance of the location variables. A comparison of Tables 4.6 and 4.9 shows that the variables ranked in terms of their importance are identical except for local relief which is added to the 20-cluster models in Table 4.9. Again the f-ratio values indicate why this difference occurs. Although the ratio value for distance to water is substantially higher in Table 4.9, the value for elevation has dropped. This means that distance to water has assumed a more dominant role in differentiating site settings, and the drop in the importance of elevation has enhanced the contributary roles that the remaining variables play. Thus the local relief variable has been added.

The question remains, however, as to the strength of these models. Again the discriminant function equations were derived and the individual site data were subjected to reclassification analysis. The results of the classification study are presented in Table 4.10. The table shows that site frequency distributions among the two sets of clusters are nonrandom as was the case for the Abo sample survey site data (see Table 4.7). Collectively both sets of models exhibit the exact same rate of correct classification, 94.4%. This is 4 to 5% lower than the models derived from the Abo survey data but nonetheless is 4% higher than the rate of success achieved with the initial modeling effort (Kemrer and Kearns 1982:55). It would therefore appear that the additional site location variability manifested in the previously recorded sites has led to the generation of models that are slightly less strong than initially thought. On the other hand, the revised variable monitoring methods and the addition of elevation has ultimately increased model strength. It should be pointed out, moreover, that a retrodictive strength of 94% is extremely high.

Another set of analyses was conducted to evaluate the "nonsite" concept (cf., Larralde and Chandler 1981; Zier and Peebles 1982; Kvamme 1983); that places where sites are not likely to occur in fact exist and can be modeled. In order to test this notion, loci within the Abo study area which do not contain sites were monitored vis-a-vis the same locational variables used for sites. The data were collected from the Abo sample survey units and well pads and other places which had been archaeologically surveyed. In all, 438 no-site loci were identified, coded and compiled into a computerized data file. Each of the no-sites were passed through the 10-cluster discriminant function equations to determine with what exact probability each locus "fitted" the site models. The distribution of no-site frequencies within probability value range classes are shown in Table 4.11. The 20-cluster set of models were discarded from this and all subsequent analyses for two reasons. First, there was sufficient evidence to show that the larger set of models was not more powerful than the smaller (see Table 4.10). Second, if efficacious site location prediction could be achieved with fewer models, then in the interest of parsimony, fewer models should be used.

Table 4.10
Reclassification Analysis of the Site-specific Location Data
for the 10-Cluster and the 20-Cluster Sets Containing
all Available Site Data

Cluster Number	No. Sites in Cluster	No. Sites Correctly Classified	(%)
1	59	55	(93)
2	1	N/A	N/A
3	6	6	(100)
4	16	16	(100)
5	49	48	(98)
6	18	17	(94)
7	96	95	(99)
8	11	11	(100)
9	39	32	(82)
10	47	42	(89)
TOTAL	342	323	(94)

Cluster Number	No. Sites in Cluster	No. Sites Correctly Classified	(%)
1	4	4	(100)
2	2	2	(100)
3	44	42	(95)
4	3	3	(100)
5	39	34	(87)
6	1	N/A	N/A
7	16	15	(94)
8	8	8	(100)
9	9	9	(100)
10	8	8	(100)
11	7	7	(100)
12	5	5	(100)
13	51	48	(94)
14	58	57	(98)
15	1	N/A	N/A
16	24	22	(92)
17	12	12	(100)
18	19	19	(100)
19	12	10	(83)
20	19	16	(84)
TOTAL	342	323	(94)

The distribution in Table 4.11 shows that the bulk of the no-site loci were classified at high probability levels as places that also contain sites. However, a comparison of the distribution within Table 4.11 and that for the 10-cluster model in Table 4.8 shows that the no-site loci performed somewhat more poorly than the site loci. There was therefore reason to believe that at least a portion of the no-site data represented loci where sites were less likely to occur and which had not been adequately taken into account by the models.

Based on this information, the models were further refined to capture both site and no-site location patterns. The data base for model derivation consisted of the location variable values for all sites, including the Abo sample survey and the previously recorded site data, and those no-site data which exhibited the poorest "fit" to the site location models. The latter were selected from the distributional array shown in Table 4.11. An inspection of this table shows a sharp increase in no-site frequencies at probabilities greater than or equal to 0.65. This break in the distribution was used as the cut-off to separate no-site loci which "fit" the site location models at acceptable levels of probability from those that did not. The 39 no-site observations which exhibit maximum probability values less than 0.65 were therefore selected for use in model refinement.

Table 4.11
Distribution of No-Site Location Data Classified by the 10-Cluster Model within Maximum Probability Classes

Probability Range Classes	No-Site Frequencies Per Classes	% of Total No-Sites Per Class
.30 - .34	0	(0)
.35 - .39	2	(0.5)
.40 - .44	4	(0.9)
.45 - .49	5	(1.1)
.50 - .54	8	(1.8)
.55 - .59	10	(2.3)
.60 - .64	10	(2.3)
.65 - .69	22	(5.0)
.70 - .74	15	(3.4)
.75 - .79	27	(6.2)
.80 - .84	20	(4.6)
.85 - .89	28	(6.4)
.90 - .94	35	(8.0)
.95 - 1.00	252	(57.5)

The next series of analyses resulted in the formulation of the final set of location models which were assessed to be most appropriate for depicting site location settings and cultural resources sensitivity for the Abo study area.

Consistent with previous model development procedures the combined site and no-site data were subjected to cluster analysis. The number of clusters permitted was set at 12, to allow the no-sites the opportunity to form additional, separate groups. The 12 clusters were then analyzed by the stepwise discriminant analysis program. The outcomes of this analysis are presented in Table 4.12. As shown in this table, only four of the eight location variables contribute significantly in distinguishing the clustered site and no-site data. Again, distance to water and elevation are the two most important variables, with view angle and drainage rank playing minor roles.

Table 4.12
Stepwise Discriminant Analysis Summary For the 12-Cluster Site and No-site Data

Step	Variable	F-Ratio	Prob>F	Prob>Lambda
1	Distance to Water	871.35	0.0001	0.0001
2	Elevation	65.06	0.0001	0.0001
3	View Angle	2.84	0.0015	0.0001
4	Drainage Rank	2.75	0.0021	0.0001

The reclassification routine was then utilized to evaluate how well the discriminant function equation derived for each cluster performed in terms of "recognizing" each of its members. The results of this analysis are presented in Table 4.13. This table shows, as in previous analysis, that cluster membership frequencies are nonrandomly distributed among the clusters. Also, only one locus was present within Clusters Nos. 6 and 12 and therefore no equations were derived for these two cases. Thus 10 equations (or models) emerged from this analysis. This rate of correct classification is high for all models and collectively several percent higher than the 10-cluster models shown in Table 4.10. The refined models are therefore strong in terms of their ability to "recognize" the 10 types of site settings represented by the equations.

Table 4.13
Reclassification Analysis of Each Locus in the Data Base
By the Eight Discriminant Function Equation Models

Cluster Number	No. Members	No. Correctly Classified	(%)
1	15	14	(93)
2	12	11	(92)
3	53	51	(96)
4	49	47	(96)
5	20	16	(80)
6	1	N/A	N/A
7	27	27	(100)
8	7	7	(100)
9	95	91	(96)
10	10	10	(100)
11	92	91	(99)
12	1	N/A	N/A
Totals	382	376	(96)

There are no strictly no-site models represented in the data. Table 4.14 shows the actual and proportional incidence of sites and no-sites within the cluster. All of the no-sites are found within clusters that contain sites. The relative incidence of sites among the clusters however, are distinctively different than no-sites. Site frequencies are extremely high in cluster Nos. 3,4,9, and 11, but no site frequencies are high in clusters 3,7, and 9. Cluster 11, moreover, which contains a large number of sites, has no no-site observations within it. This observed differential distribution of sites and no-sites within the clusters raised the possibility that the models have in fact distinguished settings which are more likely to contain sites from those where sites are relatively rare.

Table 4.14
Distribution of Sites and No-Sites Among the Clusters

Cluster Number	Site Frequency	(%)	No-Site Frequency	(%)
1	15	(4.4)	0	(0)
2	11	(3.2)	1	(2.6)
3	44	(12.9)	9	(23.1)
4	47	(13.8)	0	(0)
5	18	(5.3)	2	(5.1)
6	1	(0.3)	0	(0)
7	17	(5.0)	10	(25.6)
8	6	(1.8)	1	(2.6)
9	79	(23.2)	16	(41.0)
10	10	(2.9)	0	(0)
11	92	(27.0)	0	(0)
12	1	(0.3)	0	(0)

A series of analyses were conducted to assess the notion of differential incidence of site occurrence among the 10 locational models. Another reclassification analysis was performed. All of the no-site data (438 observations) were passed through the 10 equations and classified into the models that they best "fit". The actual and proportional distributions of the classified site and no-site data among the 10 models are shown in Table 4.15. The model numbers correspond to those assigned to the clusters from which the discriminant function equations were initially derived. Also shown in this table is a chi-square analysis of these two distributions. In this analysis, the number of no-sites classified into each model were considered the observed (o) frequencies. Expected (e) frequencies were generated by the percentage of all sites classified into each model. If there are no significant differences between the observed and expected frequencies then the sum of the chi-square values at the 95% level of confidence should not exceed 16.92 (cf. Croxton 1953). Clearly this is not the case, and the site and no-site frequencies are highly significantly different.

Inspection of the site and no-site frequencies and the chi-square rates for each model shows a nearly perfect inverse relationship. Those models which contain relatively high site frequencies (models 4 and 11) exhibit low no-site frequencies. Conversely, those models containing relatively few sites (models 1, 3, 5, 7 and 10) possess relatively high numbers of no-sites. The three exceptions to this (models 3, 8 and 9), may reflect the relative incidence of these site settings within the Abo study area. This topic will be subsequently addressed. Nonetheless, it would appear that the inverse relationship between site and no-site frequencies within the models may indicate the likelihood that each locational setting would contain sites.

Table 4.15
Frequency Distributions and Chi-Square Analysis of Sites and No-sites Classified by the Ten Models

Model Number	Site Frequency	(%)	No-site (o) Frequency	(%)	e	$\frac{(o-e)^2}{e}$	No-sites are:
1	14	(4.1)	35	(8.0)	18	16.06	High
2	11	(3.2)	30	(6.8)	14	18.28	High
3	43	(12.6)	67	(15.3)	55	2.61	--
4	48	(14.0)	34	(7.8)	61	11.95	Low
5	16	(4.7)	36	(8.2)	21	10.71	High
7	17	(5.0)	54	(12.3)	22	46.54	High
8	6	(1.8)	12	(2.7)	8	2.00	--
9	79	(23.1)	99	(22.6)	101	0.04	--
10	12	(3.5)	31	(7.1)	15	17.07	High
11	96	(28.0)	40	(9.1)	123	56.00	Low
Totals	342		438				

Where:

$X^2 = 181.27$
df = 9
$p < .00001$

In order to assess the possibility that the models reflect differential cultural resources sensitivity, it was essential to examine the representativeness of the site and no-site data. One analysis that served this, as well as other purposes, was the development of another set of observations that was designed to be as representative of the kinds of locational settings that exist within the entire Abo study area as possible. The eight locational variables were monitored for two loci within every section of land within the Abo study area. The two loci were selected on the basis of meeting two criteria. First, both loci had to be as representative of the kinds of settings present within that square mile of land as possible. Second, each of the two loci had to be as contrastive in terms of locational characteristics from its partner as possible. Thus the sample was designed to capture both setting representativeness and diversity within the study area. Previously monitored site and no-site loci were utilized as observations if and only if they met the two selection criteria. Approximately 20% of the previously recorded data qualified as valid observations. In all, 2,022 observations were made. This data set was coded and compiled into another computerized data file. These data were then passed through the 10 discriminant function equation models, using the reclassification routine. Thus each locus was assigned membership to a particular model. Since the criteria for selecting these loci were designed to be as representative as possible, these observations should accurately indicate the relative incidence of the types of settings specified by the models within the Abo study area and thus serve as a valid basis for assessing the representativeness of the site and no-site data. Table 4.16 presents a series of relative and actual distributions within the 10 models: the Abo sample survey sites, the previously recorded sites and the 2,022 independent observations. There is evidence in Table 4.16 to show that the two sets of site data exhibit similar frequency patterns among the models. Both data sets show high site frequencies in models 3, 4, 9 and 11 and low site frequencies in models 1, 2, 5, 7, 8 and 10. The previously recorded site frequencies may be skewed somewhat, for the proportional incidence of sites in model 11 is many times as high as that contained within the Abo sample survey data.

A comparison of the incidence of the combined sites and no-sites with the set of independent observations also shows similarities, with proportionately high frequencies in models 3, 4, 9 and 11 and low frequencies in models 1, 8 and 10. Although these frequencies approximate each other, there is evidence to show that the amount of site and no-site data is still insufficient to be considered reliable. A chi-square analysis between these two sets of data where the percentages for the independent observations were used to predict frequencies within the models for the combined site and no-site data showed a highly significant difference ($X^2 = 103.10$; df = 9; $p < 0.0001$). Therefore, consistent with the analysis of the adequacy of the sample survey data (see Section 4.1) considerably more site and no-site survey data are required to develop cultural resources models that meet statistically acceptable standards, particularly vis-a-vis reliability, precision and accuracy.

This does not preclude first approximation prediction, however. Thus with the caveat that data requirements have not been met to render these models reliable in terms of extrapolation beyond the data currently available with any specifiable degree of confidence, a first approximation prediction analysis was performed. Based on the data from Table 4.15, the models were ranked in

Table 4.16
Distribution of Sites, No-sites and Independent Observations Within the 10 Location Models

Model No.	Abo Survey Sites	(%)	Previously Recorded Sites	(%)	All Sites	(%)	No-Sites	(%)	Site + No-Sites	(%)	Independent Observations	(%)
1	6	(4.8)	8	(3.7)	14	(4.0)	35	(8.0)	49	(6.3)	120	(8.9)
2	5	(4.0)	6	(2.8)	11	(3.2)	30	(6.8)	41	(5.3)	189	(9.3)
3	21	(16.7)	22	(10.2)	43	(12.6)	67	(15.3)	110	(14.2)	253	(12.5)
4	23	(18.2)	25	(11.6)	48	(14.0)	34	(7.8)	82	(10.6)	214	(10.6)
5	5	(4.0)	11	(5.1)	16	(4.7)	36	(8.2)	52	(6.7)	249	(12.3)
7	6	(4.8)	11	(5.1)	17	(5.0)	54	(12.3)	71	(9.2)	167	(8.3)
8	3	(2.4)	3	(1.4)	6	(1.7)	12	(2.7)	18	(2.3)	128	(6.3)
9	35	(27.8)	44	(20.4)	79	(23.1)	99	(22.6)	178	(23.0)	320	(15.8)
10	1	(0.8)	11	(5.1)	12	(3.5)	31	(7.1)	43	(5.6)	144	(7.4)
11	21	(16.7)	75	(34.7)	96	(28.1)	40	(9.1)	130	(16.8)	233	(11.5)
Total	126		216		342		438		774		2022	

terms of cultural resources sensitivity. This was measured in terms of relative site "saturation" within the settings described by the models. For example, Table 4.15 shows that the incidence of sites is threefold higher than no-sites in model 11 loci. Even if the magnitude of this difference has been overly inflated by the previously recorded sites, the incidence is a least twice as high as no-sites (see Table 4.16), and is the highest site:no site value among all of the models. Therefore, the locational setting described by model 11 can be said to be the most "saturated" by sites and the likelihood of encountering a site in this setting is approximately 66%. Again, this is a first approximation estimate and it is impossible to determine how precise this estimate is. Table 4.17 presents the models ranked in terms of site/no-site incidence expressed as percents. These roughly correspond to cultural resource sensitivity estimates with rank 1 being the most sensitive and rank 10 the least. The relative incidence of the settings as measured by the 2,022 independent observations within the Abo study area is also shown in this table as an estimate of the amount of area affected by these sensitivity rankings.

Table 4.17
The Locational Models Ranked in Terms of Cultural Resources Sensitivity

Rank Value	Model Number	Site Saturation	Incidence in Abo Area
1	11	66%	11.5%
2	4	59%	10.6%
3	9	44%	15.8%
4	3	39%	12.5%
5	8	33%	6.3%
6	5	31%	12.3%
7	1	29%	5.9%
8	10	28%	7.4%
9	2	27%	9.3%
10	7	24%	8.3%

The "saturation" estimates indicate that sites do occur with relatively high incidence in all settings for the greatest odds of encountering a site (in model 11 settings) are 1 in every 1.5 instances and the least (model 7 settings) are approximately one in every four instances.

4.3 LOCATIONAL AND CULTURAL CHARACTERISTICS OF THE MODELS

The specific locational characteristics of the models are highly patterned when examined in terms of their sensitivity rankings. Table 4.18 lists the locational properties expressed in terms of means and ranges for the four variables which contribute significantly to model membership - distance to water, elevation, view angle and drainage rank (see Table 4.12). A number of general patterns are evident in these data. The models which specify the most sensitive settings (models 11, 4, 9 and 3 respectively) are located at

relatively short distances to water supplies, and are generally confined to the Pecos River and its major tributaries and exhibit high variable view angles. In contrast, those settings where sites occur more rarely are located at greater distances from all types of reliable water supplies and tend to exhibit expansive views of the surrounding terrain and therefore less variability in view angles.

When each model is examined more carefully, the interaction of the four major variables which distinguish the groups from each other becomes apparent. This is particularly true vis-a-vis elevation. Beginning with Model 11 in Table 4.18, it is apparent that the occurrence of these settings is geographically restricted to relatively short distances from the Pecos and its major tributaries at elevations that do not exceed 3900 feet. This indicates that Model 11 loci do not geographically extend beyond the eastern and central portions of the study area (see the study area map, Figure 1.2). This zone, moreover, is assessed to be the most archaeologically sensitive in the Abo study area.

The second highest sensitivity zone, defined by Model 4, begins geographically where Model 11 terminates. Note that the elevation range begins just beyond the uppermost limit of Model 11 and extends to the highest elevations which are located in the westernmost portion of the study area. Similar to Model 11, this zone is also located at short distances from water supplies.

Model 9, the third most sensitive setting for site occurrence, is geographically defined as a zone which is actually a band which parallels the Pecos and its major tributaries extending immediately beyond the distance from water ranges exhibited by Model 11, and confined to the eastern and central portion of the study area.

Just as Model 4 geographically complemented Model 11, Model 5 is the counterpart of Model 9. Note that these settings also form a band which parallels the water supplies at the higher elevations in the western portion of the study area and represents loci that extend immediately beyond the distance to water ranges exhibited by Model 4.

Model 3, the fourth most sensitive model also forms a band of loci along the Pecos and its major tributaries in the eastern and central portion of the study area. This band extends just beyond that described by Model 9. The geographic counterpart of Model 3 is Model 2 which forms a similar band of loci in the westernmost portion of the study area, just beyond the zone formed by Model 5.

Model 8, the fifth most sensitive type of setting, is also distributed as a band of loci which, on the basis of elevation, are located in the westernmost portion of the study area. These loci are situated at relatively great distances from tributary drainages and other minor water supplies beyond those places defined by Model 2. The location equivalent of Model 8 is Model 7 loci which are distributed as a band within the eastern and central portion of the study area, immediately beyond (in terms of distance to water) those loci described for Model 3.

Table 4.18
Locational Characteristics of the Ten Models Listed by Sensitivity Rank

Model No. (Sensitivity Rank)	Distance to Water		Elevation		View Angle		Drainage Rank	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
11 (1)	157	0-400	3687	3510-3900	257	50-360	1.7	1-3
4 (2)	131	0-400	4078	3920-4425	262	30-360	3.3	1-9
9 (3)	772	450-1000	3753	3530-4000	228	6-360	2.0	1-4
3 (4)	1323	1100-1600	3776	3510-4150	225	50-360	2.0	1-3
8 (5)	2900	2700-3200	4219	4047-4430	239	100-360	5.3	2-9
5 (6)	890	500-1300	4226	4095-4490	296	110-360	3.5	1-9
1 (7)	2627	2400-3000	3714	3580-3780	290	180-360	2.3	1-9
10 (8)	3680	3300-4000	3756	3600-4000	216	110-360	2.1	1-9
2 (9)	1817	1400-2000	4317	4070-4440	279	125-360	3.2	1-9
7 (10)	1963	1700-2300	3842	3625-4170	215	150-360	2.6	1-9

Finally, Model 10 loci which contain relatively few sites are located at great distances from water sources in the eastern and central portion of the study area.

Collectively, the loci described by the models are geographically expressed as a series of bands which parallel and extend outward from the drainage systems and other water sources in the Abo study area. Thus cultural resources sensitivity decreases with increasing distances from water supplies. Again it must be stressed that these patterns apply only to the observed data and may not prove accurate for the entire study area when data sufficiency requirements are met.

Analyses of site types within the models reveal distinctive patterning. Table 4.19 shows the distribution of site types within the models ranked in terms of sensitivity. The site types utilized here follow the criteria set forth in Chapter 3. All sites in the archaeological data base were assigned to a particular site type. Since some critical observations were often missing, it was not possible to distinguish between Type 3 (lithic procurement loci) and Type 4 (limited activity loci) in the previously recorded site data. Consequently another class labeled Type 3/4 was created for use in Table 4.19.

Generally, site type variability decreases directly with sensitivity ranking. Thus those settings that were utilized most intensively exhibit the greatest range of behavioral outcomes.

Far more striking patterns emerge when these data are arranged by location within the study area as well as distance to water - the variable that contributed most significantly to site setting differentiation. This information is presented in Table 4.20. As discussed previously the elevation variable tended to segregate the Abo study area into two subareas - the eastern and central subarea containing the Pecos River and its major tributaries, and the western subarea containing mostly tributary drainages and the limestone hill country located in the westernmost portion of the study area. As shown in Table 4.20, site type diversity decreases in both subareas with increasing distance from water sources. In the eastern and central subarea, the least complex site types, lithic procurement loci (Type 3 sites) and limited activity loci (site Type 4) as well as sites which represent either of these two classes (Type 3/4) collectively increase directly with distance to water. Multiple activity loci (Type 2 sites), however, remain relatively populous in all water source distance classes. Multiple use locales (Type 1), late prehistoric architectural sites (Types 6 and 7) and historic structural sites (Type 5) occur with greatest incidence at shorter distances from water supplies.

In the western subarea, site type diversity also decreases with distance to water, but there are some important differences from the patterning observed in the eastern and central subarea. First, multiple activity loci (Type 2 sites) occur with substantially lower incidence in the western subarea, although similar to the eastern and central subarea, they tend to exhibit a relatively even distribution in all distance-to-water categories. Second, the site type array for the western subarea is dominated by lithic procurement and limited activity loci (Types 3, 4 and 3/4). Collectively the sites that fall within these classes consistently comprise at least half of the site in the assemblages of all distance-to-water categories.

Table 4.19
Distribution of Site Types by Model

Model Number (Sensitivity Rank)		SITE TYPE *																
		1	(%)	2	(%)	3	(%)	4	(%)	3/4	(%)	5	(%)	6	(%)	7	(%)	TOTALS
11	(1)	3	(3)	49	(52)	4	(4)	5	(5)	23	(24)	1	(1)	2	(2)	2	(2)	94
4	(2)	1	(2)	17	(35)	2	(4)	14	(29)	13	(27)	1	(2)	0	(0)	0	(0)	48
9	(3)	3	(4)	44	(56)	6	(8)	7	(9)	16	(20)	2	(2)	0	(0)	1	(1)	79
3	(4)	0	(0)	24	(55)	3	(7)	5	(11)	12	(27)	0	(0)	0	(0)	0	(0)	44
8	(5)	0	(0)	3	(50)	0	(0)	2	(33)	1	(17)	0	(0)	0	(0)	0	(0)	6
5	(6)	0	(0)	4	(22)	1	(6)	4	(22)	9	(50)	0	(0)	0	(0)	0	(0)	18
1	(7)	0	(0)	8	(53)	0	(0)	2	(13)	5	(33)	0	(0)	0	(0)	0	(0)	15
10	(8)	0	(0)	4	(36)	0	(0)	1	(9)	6	(54)	0	(0)	0	(0)	0	(0)	11
2	(9)	0	(0)	4	(36)	0	(0)	2	(18)	5	(45)	0	(0)	0	(0)	0	(0)	11
7	(10)	1	(6)	7	(43)	0	(0)	4	(25)	4	(25)	0	(0)	0	(0)	0	(0)	16

* 1 = multiple use locus
2 = multiple activity locus
3 = lithic procurement locus
4 = limited activity locus

3/4 = either Type 3 or 4
5 = historic architectural
6 = prehistoric pithouse
7 = prehistoric masonry structure

Table 4.20
Distribution of Site Types Listed by Distance to Water and Subarea

Model No.	Distance to Water	1	(%)	2	(%)	3	(%)	4	(%)	3/4	(%)	5	(%)	6	(%)	7	(%)	TOTALS
EASTERN AND CENTRAL SUBAREA																		
11	0-400	3	(3)	49	(52)	4	(4)	5	(5)	23	(24)	1	(1)	2	(2)	2	(2)	94
9	450-1000	3	(4)	44	(56)	6	(8)	7	(9)	16	(20)	2	(2)	0	(0)	1	(1)	79
3	1100-1600	0	(0)	24	(55)	3	(7)	5	(11)	12	(27)	0	(0)	0	(0)	0	(0)	44
7	1700-2300	1	(6)	7	(43)	0	(0)	4	(25)	4	(25)	0	(0)	0	(0)	0	(0)	16
1	2400-3000	0	(0)	8	(53)	0	(0)	2	(13)	5	(33)	0	(0)	0	(0)	0	(0)	15
10	3300-4000	0	(0)	4	(36)	0	(0)	1	(9)	6	(54)	0	(0)	0	(0)	0	(0)	11
TOTALS		7	(3)	136	(52)	13	(5)	24	(9)	66	(25)	3	(1)	2	(1)	3	(1)	259
WESTERN SUBAREA																		
4	0-400	1	(2)	17	(35)	2	(4)	14	(29)	13	(27)	1	(2)	0	(0)	0	(0)	48
5	500-1300	0	(0)	4	(22)	1	(6)	4	(22)	9	(50)	0	(0)	0	(0)	0	(0)	18
2	1400-2000	0	(0)	4	(36)	0	(0)	2	(18)	5	(45)	0	(0)	0	(0)	0	(0)	11
8	2700-3200	0	(0)	3	(50)	0	(0)	2	(33)	1	(17)	0	(0)	0	(0)	0	(0)	6
TOTALS		1	(1)	28	(34)	3	(4)	22	(26)	28	(34)	1	(1)	0	(0)	0	(0)	83

In summary, site type diversity and behavioral complexity is inversely related to distance from water supplies throughout the Abo study area. The incidence of multiple activity loci, however, is higher throughout the eastern and central subarea than in the western subarea. In contrast, the incidence of less behaviorally complex sites, namely lithic procurement and limited activity loci, is higher throughout the western subarea. These data indicate that the locational models have captured, at least in the existing data, general patterns of occupational intensity and differential usage of the study area. These studies also serve to demonstrate the analytical utility of the site typology developed from this project and its potential for reconstructing prehistoric and historic settlement-subsistence systems within this region.

Cultural/temporal patterning is also captured by the locational models. Table 4.21 shows the distribution of cultural/temporal components within the 10 models. The models are listed by their assessed sensitivity ranking in the table. Six generalized cultural/temporal categories are presented in Table 4.21 since most of the sites could not be assigned to a particular phase within these classes. The categories nonetheless correspond to temporal periods ranging from 10,000 BC (Paleoindian) to the early twentieth century (Anglo). The only exceptions to this are the components assigned to the Unknown Prehistoric category. Basically, these are lithic scatters which lack ceramics or other culturally/temporally diagnostic artifacts.

As illustrated in Table 4.21 the cultural/temporal diversity that can be positively identified within all existing site data tends to decrease with sensitivity ranking. This trend complements that found for site type distributions, for sites that tend to be behaviorally complex generally correspond to those which are more likely to contain diagnostic artifacts. Consequently as behavioral diversity decreases, the ability to assign site components to a particular period also decreases. The decrease in cultural/temporal diversity is therefore more apparent than real, for it is highly likely that the undiagnostic lithic scatters were generated by groups using the Abo study area within the entire prehistoric and protohistoric sequence.

There is no evidence to show pronouncedly differential spatial patterning regarding the occupation and use of the Abo study area within or between cultural/temporal periods. Identical to the analysis of site type distributions, the cultural/temporal data were arranged in terms of the spatial zones described by the models and are displayed in Table 4.22. As shown in this table, the relative incidence of each cultural/temporal group is nearly the same in both subareas. Superficially, it would appear that occupational intensity of the Abo area increases through time within the prehistoric period. However, this pattern may also represent the outcomes of skewing due to the incidence of diagnostic artifacts combined with the outcomes of erosional and depositional effects. Certainly this is a problem domain that requires additional investigation.

Where sufficient data are available, there is evidence to show that virtually all zones within each subarea were utilized through time. As illustrated in Table 4.22, Archaic and Mogollon sites are scattered throughout the distance-to-water value ranges in both subareas. Based on this information it is therefore likely that the undiagnostic lithic scatters were generated over a considerable range of time.

Table 4.21
Distribution of Cultural/Temporal Components by Model

CULTURAL/TEMPORAL CATEGORY

Model Number (Sensitivity Rank)		Paleo-indian	(%)	Archaic	(%)	Mogollon	(%)	Plains	(%)	Anglo	(%)	Unknown Prehistoric	(%)	TOTALS
11	(1)	1	(1)	8	(8)	24	(25)	1	(1)	1	(1)	60	(63)	95
4	(2)	0	(0)	3	(6)	11	(22)	1	(2)	1	(2)	33	(67)	49
9	(3)	0	(0)	3	(4)	20	(25)	0	(0)	1	(1)	55	(70)	79
3	(4)	0	(0)	5	(11)	12	(27)	0	(0)	0	(0)	27	(61)	44
8	(5)	0	(0)	0	(0)	1	(17)	0	(0)	0	(0)	5	(83)	6
5	(6)	0	(0)	0	(0)	2	(11)	0	(0)	0	(0)	16	(89)	18
1	(7)	0	(0)	1	(7)	2	(13)	0	(0)	0	(0)	12	(80)	15
10	(8)	0	(0)	0	(0)	2	(18)	0	(0)	0	(0)	9	(82)	11
2	(9)	1	(9)	1	(9)	2	(18)	0	(0)	0	(0)	7	(64)	11
7	(10)	0	(0)	0	(0)	2	(12)	0	(0)	0	(0)	14	(88)	16
TOTALS		2	(1)	21	(6)	78	(23)	2	(1)	3	(1)	238	(69)	344

Table 4.22
Cultural/Temporal Component Distributions by Subarea and Distance to Water

Model No.	Distance to Water	Paleo-indian	(%)	Archaic	(%)	Mogollon	(%)	Plains	(%)	Anglo	(%)	Unknown Prehistoric	(%)	TOTALS
						EASTERN AND CENTRAL SUBAREA								
11	0-400	1	(1)	8	(8)	24	(25)	1	(1)	1	(1)	60	(63)	95
9	450-1000	0	(0)	3	(4)	20	(25)	0	(0)	1	(1)	55	(70)	79
3	1100-1600	0	(0)	5	(11)	12	(27)	0	(0)	0	(0)	27	(61)	44
7	1700-2300	0	(0)	0	(0)	2	(12)	0	(0)	0	(0)	14	(86)	16
1	2400-3000	0	(0)	1	(7)	2	(13)	0	(0)	0	(0)	12	(80)	15
10	3300-4000	0	(0)	0	(0)	2	(18)	0	(0)	0	(0)	9	(82)	11
TOTALS		1	(.4)	17	(7)	62	(24)	1	(.4)	2	(1)	177	(68)	260
						WESTERN SUBAREA								
4	0-400	0	(0)	3	(6)	11	(22)	1	(2)	1	(2)	33	(67)	49
5	500-1300	0	(0)	0	(0)	2	(11)	0	(0)	0	(0)	16	(89)	18
2	1400-2000	1	(9)	1	(9)	2	(18)	0	(0)	0	(0)	7	(82)	11
8	2700-3200	0	(0)	0	(0)	1	(17)	0	(0)	0	(0)	5	(83)	6
TOTALS		1	(1)	4	(5)	16	(19)	1	(1)	1	(1)	61	(73)	84

In summary, it is apparent that the locational models have partitioned the study area into geographically defined zones. The archaeological content of these zones specify differential sensitivity in terms of relative site incidence. They also specify differential behavioral or usage content as specified by site types. With the information currently available, however, it is unclear that the models specify differential cultural/temporal usage of the study area.

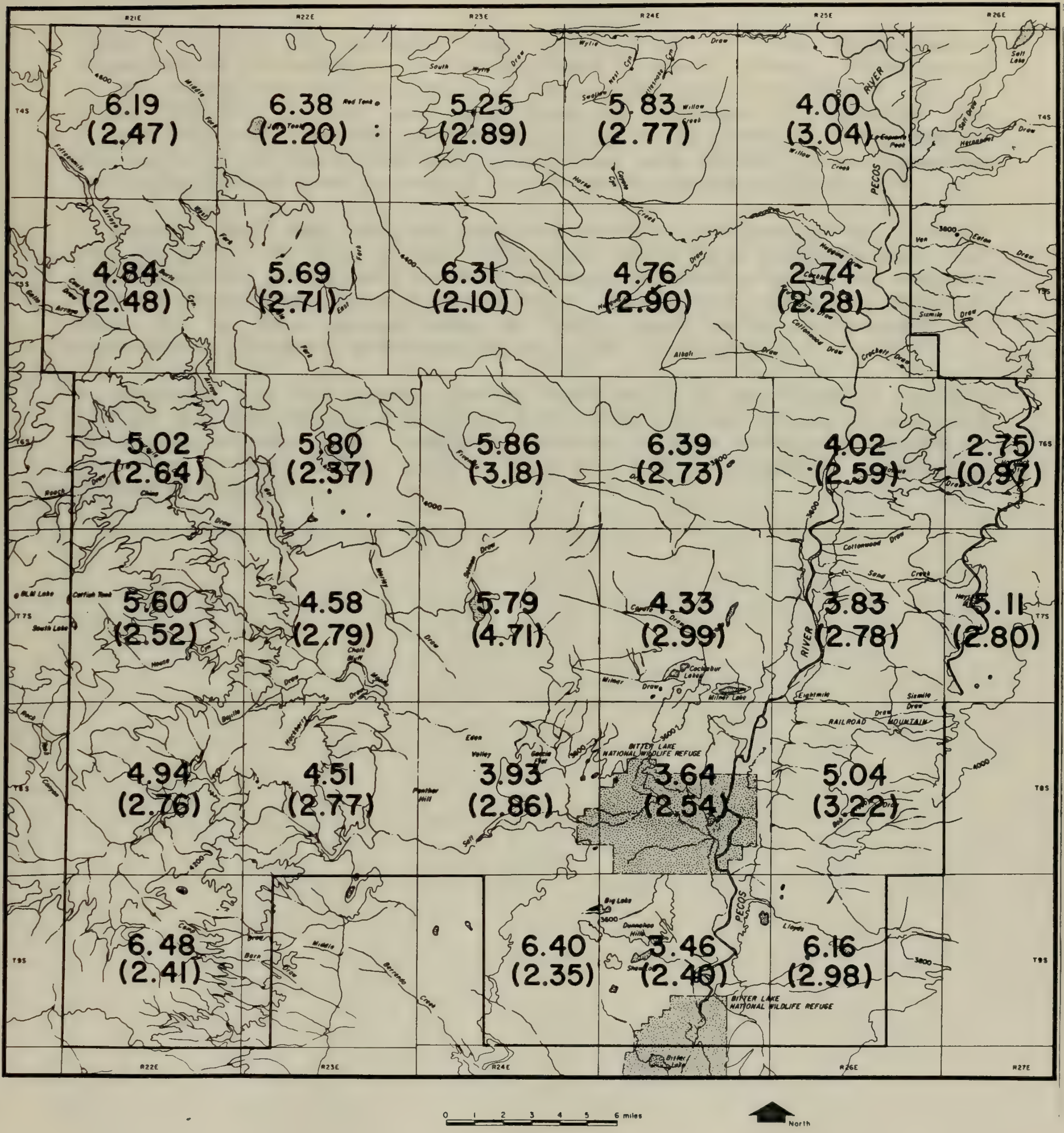
4.4 AN APPRAISAL OF CULTURAL RESOURCES SENSITIVITY DISTRIBUTIONS WITHIN THE ABO STUDY AREA

The spatial distribution of assessed cultural resource sensitivity values within the Abo study area exhibits a considerable amount of variability. The raw distributions of the model-classified 2,022 loci systematically monitored throughout the study area are expressed in terms of their sensitivity rank value and is presented in the enclosed study area map (see Map Pocket). As discussed previously (Table 4.15, et seq.) these values represent the relative incidence of site occurrence among the locational setting defined by the models. Thus loci exhibiting a rank value of 1 are assessed to be the places where sites are likely to occur with the highest incidence. Conversely, those with a rank value of 10 share setting characteristics where site incidence is assessed to be the lowest. Again it must be stressed that this array represents a first approximation only, for there are insufficient data to determine the precision of these assessments (see Section 4.2).

Despite the high amount of variability, there is spatial patterning in these data. As discussed in the previous section of this chapter, each of the models describes a discrete geographically definable zone within the study area. Settings that share the highest sensitivity ranking (rank value = 1) are located 0 - 400 meters from reliable water supplies and at elevations ranging from approximately 3500 - 3900 feet (see Table 4.18). As shown in the enclosed map, values of 1 virtually outline the Pecos River and its major tributaries in the eastern and central portion of the study area. In contrast, the lowest sensitivity zones (rank values 7 - 10) are generally located at distances greater than 1,000 meters from water resources throughout the study area and this fact is also reflected in the enclosed map. Moreover, the spatial characteristic of the models in relationship to each other within the study area (see Table 4.18, et seq.) can also be seen in the enclosed map.

There are some general patterns in assessed sensitivity variation in the Abo study area. Figure 4.1 summarized the rank value data presented in the enclosed map by average (mean) sensitivity rank is summarized Township/ Range unit. The numbers in parentheses represent the standard deviation from each mean. The archaeological importance of the Pecos River Valley is clearly shown in Figure 4.1, for the mean sensitivity rank values are are consistently lower in those township/range units containing the Pecos River than the adjacent units. Moreover, within the Pecos Valley, the units which exhibit the lowest values correspond to those which contain the greatest number of tributary drainages. The least sensitive areas (i.e., those units with the highest mean sensitivity rank values) are located in the northwestern, southern and the north-central portions of the study area. It must be emphasized, however, that the data in Figure 4.1 merely illustrate general

Figure 4.1
Distribution of Mean Sensitivity Values within the Abo Study Area.
(Parenthetic Values Represent Standard Deviations)



trends, for the standard deviations indicate that substantially higher and lower sensitivity rank values are present in all township/range units. The enclosed map in the Map Pocket shows this high amount of intra-unit sensitivity variation.

Figure 4.1 and the enclosed map also provides a first approximation assessment of the adequacy of the Abo Class II sample survey. As indicated in the formal statistical appraisal of sample adequacy (see Section 4.1), a larger fraction of the Abo area must be surveyed to estimate site density/frequency variation with acceptable levels of precision. This fact is reinforced by the data from the enclosed map and Figure 4.1 are compared with those derived from the sample survey results shown in Figure 3.50.

It appears likely that cultural resources content of Township (T) 8 South (S), Range (R) 22 East (E) and T8S, R23E was severly underestimated, for high sensitivity loci as well as moderate mean sensitivity levels are assessed to occur within these township/range units. In contrast, sites were found in three out of four sample units in T45S, R22E which is probably an overestimate of cultural resources incidence for this land unit.

In summary, the site location models developed from the Class II and the existing site and no-site data appears to have captured strong location and site incidence patterning. Additional data and further testing is required to assess the precision of this model to fully meet cultural resources management application standards.

Chapter 5

EVALUATION AND SIGNIFICANCE OF SITES

5.1 INTRODUCTION

Cultural resources are deemed significant if they meet any criterion for inclusion in the National Register of Historic Places (NRHP), or are assessed to be places of sacred/religious significance to Native Americans. The enabling legislation for the identification and protection of NRHP eligible properties is the National Historic Preservation Act of 1966 (as amended; 16 USC 470). The procedures for the identification and protection of such properties in the context of ground disturbing activities on public lands are specified in regulations (36 CFR 800). The legislative basis for the identification and protection of properties significant to Native Americans is the American Indian Religious Freedom Act of 1978 (AIRFA; 42 USC 1996). Regulations governing the management of these resources on Indian lands have been finalized for the Bureau of Indian Affairs (25 CFR 281), and the Advisory Council on HIstoric Preservation is currently developing guidelines for AIRFA compliance applicable to the management of other public lands. Moreover, American Indian concerns regarding the protection of such places have been identified for the State of New Mexico (Holmes 1982). The potential for the existence of places which have sacred/religious significance to Native Americans does exist in the Abo area due to its proximity to and former use by the Mescalero Apache.

There are four major criteria for evaluating the National Register of Historic Places eligibility of cultural resources [36 CFR 60.6(a),(b),(c),(d)]. NRHP significant resources are those properties:

(a) That are associated with events that have made a significant contribution to the broad patterns of our history; or

(b) That are associated with the lives of persons significant in our past; or

(c) That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

(d) That have yielded, or may be likely to yield, information important in prehistory or history.

An example of a property in the Abo region that would meet criterion (a) would be a building or place that had direct pertinence to the late nineteenth century Lincoln County Wars. Examples of properties meeting criterion (b) would include the birthplaces of historically famous individuals such as social, political or military leaders. Numerous properties which would meet criterion

(c) probably exist within the Abo area. Examples include well-reserved or restorable prehistoric sites or properties from the Homesteading Era such as dugout dwellings, early ranch houses, and early Industrial Era towns such as the ghost town of Acme. Criterion (d) which clearly includes prehistoric and historic archaeological sites is the most important measure of significance that could potentially apply to the majority of the resources in the Abo area. This criterion is therefore discussed in detail below.

The following section presents a series of research questions or problem domains considered apropos to the archaeology of southeast New Mexico and the research potential of the cultural remains within the Abo study area. This includes a review of the data requirements needed to address these problems, followed by a series of site specific examples of assessed values from the Abo sample survey inventory.

The perspective in which these data are presented follows Scovill, Gordon and Anderson (1977:46).

> These cultural debris are a vast, unread, and as yet untranslated library of decipherable data that contain the total knowable sum of knowledge of human activities on this continent from the most ancient times until the most recent past. We have just begun to 'read' and to 'decipher' this vast storehouse of knowledge. What we know now is infinitesimal, fragmentary and inconclusive if evaluated in terms of the potential knowledge that exists undisturbed, unstudied and as yet undestroyed in the remaining cultural debris of the nation.

It is imperative that the investigation of archaeological properties (survey or excavation) be guided by a set of research goals or specific problem orientations. This provides a forum for the evaluation of cultural resources that is as pertinent to a management perspective as it is to an academic or "pure" research perspective. Managers must have sufficient information to make a responsible evaluation of the potential for a cultural resource to provide information pertinent to a broad spectrum of research questions. Information must be supplied by researchers or contractors engaged in cultural resource management related projects (c.f., Zale 1983) to aid cultural resource managers in the evaluation process answers to the following set of questions should accompany every inventory or survey report.

1. What temporal periods are represented by the cultural resources?

2. What activities are represented by the cultural resources?

3. What is the potential for depth or buried cultural deposits?

4. What is the potential for datable remains?

5. What is the integrity of the resources and what is the potential for studies related to site structure?

6. What is the potential for the archaeological property to provide information pertinent to culture change, activity patterning, land use, social organization or other research problem?

7. What specific analytical studies may be applicable to future interpretation of the cultural resources?

8. What data recovery methods are necessary to realize the information potential of the cultural resources?

9. What are the possible alternatives to the proposed action?

10. Are the cultural resources significant enough to warrant inclusion in the National Register or State Register of Historic Places? Are they significant in terms of general, regional or local archaeological research goals or problem domains?

Cultural resources are non-renewable and once destroyed can never again be evaluated or interpreted from any perspective. It is not sufficient to simply record a site as though it exists in a vacuum, or as Judge (1972a) has noted "there is little value in simply recording a site because it's there". From a management perspective where the potential for loss of a cultural resource is high, it is critical that the collection of archaeological data be broad enough to satisfy the requirements of a variety of research orientations, not just the focal interests of the individual investigator. To guide the acquisition of cultural resource data, archaeologists must be cognizant of the research goals and problem domains considered critical by other researchers both within their region, and in the broader realm of archaeological and anthropological study. They must address questions pertinent to a broad spectrum of archaeological goals and conscientiously strive to collect the data necessary to address those questions. This position is best illustrated by Binford (1964), who advocated a regional perspective and the development of a research design oriented toward the explanation of general anthropological problems. The Abo study area encompasses a significant record of past human behavior. It thus provides an important data base from which various hypotheses concerning culture history and culture process might be tested.

5.2 PROBLEM DOMAINS

The following sections outline a series of problem domains which are considered applicable to the identification of significant data values for sites within the Abo project area. These incorporate regional research problems that are germane to the study of cultural resources in southeastern New Mexico and others that have broader relevance. Included are questions pertaining to cultural-temporal and behavioral issues.

5.2.1 Chronology

Perhaps the foremost research problem facing archaeologists engaged in cultural resource studies in southeast New Mexico is chronology. Following work on the Llano Estacado in 1956, Jelinek (1967:1) observed "that virtually nothing was known of the eastern border of the Southwest in the area we had been working, and of this area of the Pecos Valley [the Middle Pecos] in particular". Jelinek (1967:2) cites several general overviews then available which incorporated the Middle Pecos Valley into their discussions. Included are Kidder's (1924) assignment of the Middle Pecos area to the Eastern Peripheral District; also Mera's (1931, 1938) work and subsequent evaluation that the area represented extensions of cultural activity from the southeastern New Mexico Sacramento Highland as far east as the Pecos River (Mera 1940:37). In 1948 Lehmer defined the Jornada branch of the Mogollon, a ceramic horizon cultural-temporal entity previously identified in southeastern and central New Mexico. Lehmer's (1948) initial definition of the extent of the Jornada Mogollon did not include the Abo study area. However, the Jornada area has been substantially increased by subsequent scholars (e.g., Corley 1965) and as currently viewed includes the Abo study area (Wiseman 1983:4). Lehmer (1948) also proposed a series of phase sequences for the Jornada branch that began with an ambiguous preceramic or Archaic phase and continued through the ceramic period (ca. AD 900 - 1450). This sequence was revised in 1965 by Corley and again by Leslie in 1979 (Corley 1965; Leslie 1979). Further work in the 1950's documented the occurrence of "temporary" and "more permanent" camps within the Abo study area and noted the presence of preceramic and ceramic horizon occupations (Fenenga and Cummings 1956). Jelinek's (1967) survey of the Middle Pecos Valley was the first real problem oriented investigation in the Abo study area vicinity. His survey and subsequent excavations were directed toward identifying the range and nature of the cultural manifestations, and toward the development of a cultural chronology for the region. Based on his own investigations and those of others in the surrounding areas, Jelinek outlined a prehistoric cultural sequence for the Middle Pecos Valley that continues to be used today. The phase sequences proposed by Lehmer and Jelinek are not the only chronological orderings proposed for the Jornada cultural resources in southeastern New Mexico. As a result of increased investigation in other areas, various researchers have established a series of regional chronologies and phase sequences. This has resulted in a plethora of confusion which, as Wiseman (1983) has recently pointed out, is primarily a taxonomic problem desperately in need of resolution.

The problems of chronology apropos to the Abo study area can be broadly separated into four general temporal horizons: the Paleoindian period, the Archaic period, the formative or ceramic period, and the late prehistoric - protohistoric period. The following discussion of chronological issues, problem domains, and research questions draws heavily on the recommendations and interpretations of previous researchers engaged in the evaluation of the cultural resources of this area particularly Camilli and Allen (1979) and Stuart and Gauthier (1981). The reader is referred to these resources for a more complete discussion of the pertinent background data and previous research.

5.2.1.1 Paleoindian

Although the current evidence of Paleoindian occupation within the study area is scant (Jelinek 1967:140,141; Bond 1979:58,59; Abo survey data this volume) it is anticipated that with increased survey and reconnaissance additional Paleoindian sites or artifacts will be documented. Current evidence indicates that representatives of several different Paleoindian complexes made use of the Abo study area. These include the Clovis and Folsom complexes of the Llano tradition (ca. 10,000 - 9000 BC), and the Cody complex and other more loosely defined terminal Paleoindian manifestations of the Plano tradition (ca. 7000 - 6000 BC). The presence of Paleoindian horizon sites representing a broad spectrum of complexes to the east of the study area has been well documented and it is not unreasonable to expect a similar situation in this region. Jelinek (1967:140), on the basis of geomorphological considerations, has suggested that the chances for an "in situ" Paleoindian sequence in the Middle Pecos Valley are slim. How realistic is this evaluation? Stuart and Gauthier (1981:262) also note there are few known Paleoindian localities in the Pecos River drainage area, and compare this with a similar pattern in the central portion of the San Juan Basin. In many areas the Paleoindian presence has left an elusive record. This should not mean it is futile to search for evidence of this horizon. Rather, there should be an increased effort made to detect or ferret out whatever traces of this record are available. Only then can we begin to address questions pertinent to this temporal period and its place in the prehistory of the study area. One additional point made by Stuart and Gauthier (1981:264) is of critical importance to the Abo study area. They propose that one settlement-subsistence strategy employed by Paleoindian groups may have involved seasonal transhumance from the broken periphery of the major basin areas (e.g., the Mescalero Pediment) to and from intervening lower elevations (e.g., the Pecos Valley). The higher elevations are viewed as the potential hunting localities while other activities not involving particularly diagnostic artifacts may have taken place in the lower elevations. They argue that the Paleoindian assemblages from the lower areas may not be recognizable to most field archaeologists, and that a real need exists for more field archaeologists to learn what Paleoindian assemblages look like when they do not contain diagnostic projectile points.

Questions considered relevant to the broader understanding of the Paleoindian occupation of the study area include:

- When were human populations first present in the study area?
- What temporal periods and cultural complexes are represented by the Paleoindian remains? Are these consistent with the Paleoindian occupation in adjacent regions?
- What was the nature of the Paleoindian occupation of the study area (e.g., cyclical or sporadic)?
- Is change in the intensity of occupation through time evident?

- What elements of the Paleoindian settlement-subsistence system(s) are present in the Abo area (lithic procurement sites, kill sites, temporary camps, staging localities)? How do these relate to settlement-subsistence systems identified elsewhere?
- How can we identify a non-hunting oriented Paleoindian occupation (i.e., one lacking diagnostic projectile points) in this region?
- Can the Paleoindian presence in the study area be interfaced with known Paleoindian occupations elsewhere to produce a broader understanding of regional land use and mobility parameters?
- How did the Paleoindian adaptation to the study area change through time?
- What were the population parameters of the Paleoindian occupation of the Middle Pecos Valley area? Is change through time evident?

5.2.1.2 Archaic

The Archaic period appears to represent a major temporal component within the study area and in the surrounding environs (Camilli 1979a:60-63,67,68; Jelinek 1967:141-143). Within the Abo project area and vicinity this cultural-temporal entity potentially spans a period from approximately 5000 BC to at least AD 600 and possibly several hundred years later (Stuart and Gauthier 1981:266-269; Jelinek 1967:143). However, even with this temporally broad occupational span the Archaic period remains one of the least known and most poorly understood cultural periods in the study area (Camilli 1979a:65-68; Henderson 1976:16; Beckett 1979: Stuart and Gauthier 1981:267).

Jelinek (1967:141-143) identified Archaic materials within the Middle Pecos Valley including early Archaic Jay and San Jose projectile points although he questioned the contextual integrity of those points. Jelinek (1967:142) tentatively identified an Archaic component within the Abo study area which he termed the "Dunahoo complex". However, he failed to provide an adequate description of the materials comprising this complex and comparison with the Abo survey assemblages is impossible. Based on point styles Jelinek (1967:143) suggested that the earlier Archaic horizons had closer cultural affinity with the Southwest than with the Plains; and that later Archaic horizons show influences from both the Southwest and west Texas. Based on projectile point styles identified during survey in the Haystack Mountain area, Bond (1979:60) suggests that the local Archaic population was more closely allied with the cultures of west and central Texas than to those to the north and west in New Mexico.

The origins and affiliation of the Archaic components within the Abo study area are essentially undetermined. Questions regarding these issues include:

- Did the Abo area Archaic horizon develop out of an indigenous Paleoindian cultural base, or move into the region from some other area?
- Does the Abo area Archaic have closer affinities to the Archaic cultures of west Texas (e.g., Johnson 1967), the Cochise culture of southeast Arizona and southwest New Mexico (Sayles 1983), the Oshara tradition of northwest New Mexico (Irwin-Williams 1973); or does the Archaic occupation of the study area represent a separate cultural entity with a distinct developmental sequence of its own?
- Is, as Jelinek (1967) suggests, change evident in the direction of influences affecting the Archaic populations of the study area? If so, what causal explanation might be evoked to account for this?

Although there is evidence to indicate considerable diversity within the Archaic sequence in the Abo project area, there is little data currently available to construct a cultural-temporal chronology for this portion of the Southwest. The development of an Archaic cultural sequence similar to those established for northwestern New Mexico (Irwin-Williams 1973) and southeastern Arizona (Sayles 1983) should be a major research goal for the Abo study area and surrounding environs. The Abo survey data indicates that there is a strong probability for an extended Archaic presence in this portion of New Mexico. Furthermore, the variation in the Abo projectile point styles and the potential for obtaining chronometric data from associated hearth features should provide an important data base upon which to build an Archaic cultural sequence. Additional suggestions regarding the establishment of an Archaic cultural chronology for this region are discussed by Stuart and Gauthier (1981:267-268).

The establishment of a cultural chronology for the Archaic is only one of the problem domains pertinent to this period. We know relatively little about the settlement and subsistence strategies employed by the Archaic populations in southeast New Mexico. Archaic cultures are traditionally viewed as generalized hunter-gatherers exploiting a broad spectrum of floral and faunal resources.

- How is this manifested in the study area?
- Is there evidence for a greater reliance on floral over faunal resources or vice versa?
- Was there greater emphasis on the acquisition of large game animals over smaller game?
- Did the subsistence base shift through time? If so, can this be related to shifts in climatic conditions or some other causal factor?
- What evidence is there to indicate the adoption of agriculture among the preceramic late Archaic populations?

The Archaic period settlement pattern is typically identified as one of high mobility involving movement over large land areas; the establishment of various temporary residential locations supplemented by smaller resource acquisition locales; and seasonal aggregation and dispersal. Thus another set of problem domains can be identified.

- How is the Archaic period settlement system manifested in the study area?
- What elements of the Archaic settlement system can be identified?
- What changes are evident in the Archaic settlement systems through time? Can these changes be attributed to shifting subsistence related to climatic variability or are other causal factors involved?
- What were the mobility parameters of the Archaic populations? How did these change through time?
- Is there evidence for seasonal transhumance within the study area or between the study area and elsewhere?
- Can the validity of the concept of base camp versus temporary camp be tested in the Abo study area?
- What were the size parameters of the Archaic population in the study area?
- What diagnostic elements can be isolated for the different Archaic temporal period assemblages?

5.2.1.3 Formative Stage

The Formative Stage occupation of the Abo project vicinity is well documented (Jelinek 1967; Kelley 1966; Ross 1975; Stuart and Gauthier 1981:268-277) and appears to have been established by approximately AD 800 (Jelinek 1967:145) and to have persisted until approximately AD 1400 or later (Ross 1975:5; Jelinek 1967:162; Stuart and Gauthier 1981:268). This temporal period is typically characterized by an agriculturally oriented subsistence system and sedentary settlement. The ceramic period populations in the Abo study area vicinity are generally considered to be a regional variant of the Jornada Mogollon. However, this is not a consistent view and some researchers identify the ceramic period sites in the study area vicinity as a Pueblo or Anasazi affiliate. Honea (1973) notes that on the Llano Estacado materials of eastern pueblo or Anasazi affiliation appear predominately in the north while eastern Mogollon materials occur to the south. Also, Jelinek (1967:148) states that by the Late 18 Mile phase cultural influences from the Northern Rio Grande Anasazi area had begun to affect the basic Mogollon pattern of the Middle Pecos tradition. Camilli (1979a:78) employs the term "Pueblo-Mogollon" for ceramic period sites in the Roswell District. Therefore, one research

question concerning this temporal period is the identification of cultural relationship or affinity. That is, are the ceramic period sites in the study area more closely aligned with the Jornada branch of the Mogollon or do they represent an extension of eastern Anasazi or Puebloan cultures? Conversely, the Abo study area appears to represent an area peripherial to the mainstream developments of both the Mogollon and Anasazi culture areas. Does the cultural manifestation represented by the ceramic period resources constitute a distinct expression of formative stage development influenced by, yet independent from, these larger cultural entities? Or, does the formative period within the Abo study area represent a local amalgamation of ideas, influences and lifeways adopted from both the Mogollon and Anasazi culture areas?

If, as Jelinek (1967) has suggested, changes through time are evident in the cultural character and external relationships of the Abo area formative stage sites. What causal factors might be influencing these changes?

The question of formative stage origins in the study area is also an important problem domain for future study. Jelinek's work indicated that the earliest formative stage occupation (Early 18 Mile phase, ca. AD 800 - 900) was characterized by "relatively permanent settlements in topographic situations suitable for the practice of maize cultivation" (1967:144). He notes, however, that this phase was probably not fully sedentary and that some of these sites were not apparently agriculturally oriented. These are characterized by quantities of rough chipped stone tools which Jelinek interprets as indicative of wild plant processing. The problem of explaining the transition from a mobile hunting-gathering cultural system to a sedentary agricultural system is one of general anthropological significance and has been discussed by various authors (Binford 1968, 1983; Cohen 1977).

- Did the Early 18 Mile phase, as Jelinek (1967:146) suggests, develop out of an indigenous Archaic hunting-gathering base?
- If so, what causal factors can be evoked to account for the abandonment of a hunting-gathering lifeway in favor of a agriculturally based one?
- Also, what avenues did this development take in the study area?

The numerous aceramic sites and small sherd and lithic sites in the project area should provide a fertile field to define and organize the relationship between preceramic cultures and those of the Abo area formative stage cultures. This can be accomplished by employing controlled problem orientation, analytical methodology, and comparison with excavated ceramic period site and Archaic site assemblages in the general vicinity.

Previous work in the study area and surrounding environs has established the presence of pithouse (shallow subterranean structures) communities; settlements characterized by slab-based surface rooms; and adobe pueblo; and pithouse communities (Jelinek 1967; Kelley 1966; Ross 1975). Jelinek (1967:146) places the initial appearance of well-established small sedentary communities in the Middle Pecos Valley during the Late 18 Mile phase (ca. AD

900 - 1000). These early communities and those of the succeeding Mesita Negra phases (ca. AD 1000 - 1200) were characterized by shallow subsurface pit structures associated with small contiguous rooms (storage facilities). This architectural form was replaced by rectangular, slab-based surface structures by the Early McKenzie phase (ca. AD 1200 - 1250), a style that continued into the Late McKenzie phase (ca. AD 1250 - 1300) when contiguous-room structures may have been in use. Sometime thereafter, and possibly somewhat contemporaneously, the use of adobe roomblock pueblo architecture in combination with pit structures developed and continued to be used until perhaps as late as AD 1450 (Kelley 1966; Ross 1975). This marks an apparent sharp departure from the preceding phases. Does this reflect a shift in settlement and social organization? Or, are different cultural entities responsible for the differences in these communities. We still know very little regarding the variability in structures and community organization from any of these time periods. For instance, Jelinek's (1967) samples of architectural variability within and between the various phases are quite limited and little additional work has been oriented toward defining the variability within any one period or the continuity between periods. Consequently a number of questions remain unanswered:

- How characteristic are Jelinek's sites of the sedentary communities within the study area?
- What causal factors affected the changes in architectural style that have been documented?
- What changes in the organization of the social structure can be correlated with the apparent changes in architecture?
- Can these changes be correlated with community growth, changing economic, subsistence or social systems, the influx of new populations or influences from outside the Middle Pecos Valley area?

Future survey work in the project area should be attuned to identifying sites that may contain structural remains. Mitigation could be directed toward the investigation of the variability in the construction techniques, form, area and internal features of these structural remains. This information could then be applied to examining the similarities and differences of structures within sites, areal differences between sites of the same time period, and variability through time. Examination of habitation structures and their relationships within and between sites can also potentially provide information regarding household size and social organization.

Another problem domain pertinent to the study of formative stage sites in the study area is the subsistence base and its influence on the structure and organization of the of the settlement systems. At present we have very little information regarding the parameters of the subsistence system employed by the formative stage occupants of the study area. Investigations encompassing ceramic period sites should attempt to identify the orientation of, and the potential variability within the subsistence base. This might be accomplished through site location studies in concert with site structure studies, assemblage and feature analyses and faunal, floral or palynological analyses.

Jelinek (1967:144-146) indicates that, although the Early 18 Mile phase sites suggest a way of life oriented toward maize agriculture, there was also a considerable reliance on undomesticated plant resources. What are the settlement system correlates of this subsistence base? Can we expect to find a number of sites from this time period that are not situated in areas conducive to agriculture? What were the restrictions on community size and permanence? Did the Early 18 Mile phase populations practice seasonal transhumance?

Jelinek (1967:161) suggests that by the Late 18 Mile phase there were "small, well-settled communities adjusted to an existence largely dependent upon farming". How dependent were these communities on agriculture? Are there other sites from this time period that reflect a reliance on undomesticated food resources as well? How was the farming system organized? Did each community farm adjacent tracts of land, or were small seasonal, temporary farmsteads established away from the community?

By the early and late Mesita Negra phases the population of the valley had apparently attained its peak and farming had reached its most intense development (Jelinek 1967:161). This interpretation raises a number of questions:

- If this is a true reflection of the formative development what was the affect on the distribution of populations throughout the area?
- Did the patterns developed during the preceding phases continue or are shifts in the settlement-subsistence system evident?
- What patterning is evident in the distribution of sites across the landscape?
- Are there centralized communities or are populations dispersed throughout the region?
- Can differences in sites from this time period be equated with differing reliances on domesticated resources versus undomesticated resources?
- Can differing farming strategies be identified either through agricultural feature recognition or variability in site structure and location?

Stuart and Gauthier (1981:270-274) have proposed that the shifts in settlement location and intensity of occupation along the Middle Pecos can be equated with larger almost statewide developments. They cite variability in intrusive ceramics and occupational intensity as key indicators of this proposed relationship. Future work within the Abo project vicinity should be oriented toward testing this hypothesis.

5.2.1.4 Late Prehistoric - Protohistoric

Sometime after approximately AD 1250, and following the period of intensive farming, there was a shift away from agriculture to bison hunting. This was accompanied by an apparent shift away from settled village life to a mobile nomadic existence (Jelinek 1967:162). A number of questions remain unanswered; for example:

- How did this shift affect the structure and composition of the settled villages?
- Can a gradual decline in village or community size be detected in the archaeological record? Or is the transition more abrupt?
- What was the nature of the "nomadic existence"? Was it first one of seasonal shifting from village to temporary camp?
- Were these "nomadic" populations relying on a pattern of seasonal transhumance?
- How did the movement and availability of the bison herds affect settlement and subsistence during this time period?

Little research has been conducted on sites of late prehistoric or protohistoric age. One major study is the investigation of the Garnsey bison kill site immediately south of the Abo survey area (Speth and Parry 1978, 1980; Speth 1983). Excavations at this locality indicate that the shift by ceramic using groups to a reliance on bison possibly continued into the early historic period (Speth 1983). How widespread this reliance was and the overall parameters of the settlement-subsistence system of this time period are still very incomplete and constitute avenues for future research.

Jelinek's (1967) work indicated that small mobile populations were present in the area during the Late Prehistoric - Protohistoric period. The presence of Rio Grande Glazeware ceramics on sites from this time period led Jelinek to suggest that the Middle Pecos Valley was traversed by groups in contact with the Rio Grande Pueblos up to the early historic period (1967:160). Who were these groups? Were they Pueblo traders or Plains indians on trading or raiding expeditions? Future researchers should be aware of the potential for discovering these ephemeral sites.

Another possible site type from this time period are tipi ring locales. At present little data is available for the study area regarding the extent, locational parameters and variability inherent in this class of sites. Future research should be oriented toward identifying the cultural group(s) responsible for their development, the function of these sites (i.e., are they really tipi rings or do they represent hide working locales?), and their numbers and distribution across the landscape.

5.2.1.5 Historic

The Abo survey data indicates that historic resources are relatively rare within the study area. However, previously recorded data does indicate the potential for encountering historic sites of various time periods and differing ethnic and functional types. Future research should be oriented toward identifying the range of variability within the historic cultural resources and their distribution throughout the study area.

One problem domain that may have applicability to the project area's historic resources concerns sites from the homestead era. For example:

- What is the nature and distribution of homestead sites in the study area?
- Do they all represent a restricted time period, or can varying episodes of homestead development be identified?
- Can the period(s) of homesteading be correlated with other factors of regional or national significance (e.g., the Depression era)?
- What factors can be identified to explain why some of these homesteading efforts failed?

5.2.2 General Problem Domains

The following is a discussion of a series of general problem domains that can be applied to survey and mitigation efforts in the Abo study area. The various techniques and avenues of research outlined in this section have strong potential for addressing some of the research questions raised in the preceding section.

5.2.2.1 Aceramic Lithic Scatters

The most commonly occurring site types in the Abo study area and surrounding environs are aceramic lithic scatters. This class of sites represents 79.23% of the Abo survey sample and investigations by other researchers in the area have returned comparable results (Stuart and Gauthier 1981:266; Bond 1979; Stuart, Allan and Eschman 1975). A major problem in Southwestern prehistory has been the determination of the temporal placement and cultural affiliation of lithic scatters which lack any readily identifiable temporal indicators (e.g., projectile points). In the case of the study area, this would include identifying the difference between lithic scatters generated by Paleoindian, Archaic, Puebloan/Mogollon or late prehistoric - protohistoric groups. One approach to this problem is through understanding the technological organization of the representative cultural systems. For example, Judge (1972b:56) notes that there are distinct differences between Paleoindian and Archaic use of specific scraper types in the central Rio Grande area of New Mexico. Additionally, specific flake types and materials

represented were considered significant Paleoindian site indicators in the same region (Judge 1972b:56,57).

Chapman (1982) has recently addressed this problem with lithic assemblages along the Low Rio Puerco River in central New Mexico. Chapman's analyses focused on variation in stages of manufacture and techniques of manufacture represented by lithic debitage assemblages from sites ranging from Archaic through Pueblo IV. His results indicate that considerable potential exists in using debitage assemblages for dating purposes, and that definite patterning in measures of core reduction trajectory and technique could be identified for different phases of occupation. Chapman (1982:284) notes that:

> At this stage of research, our work effort requires baseline data acquisition from a great diversity of archaeological contexts both dated and undated if we are to isolate how the selection of raw material, technological procedures and settlement strategies operated interactively to result in deposition of some kinds of lithic assemblages at some sites but not others.

Archaeological sites in the Abo project area have a high potential for providing positive input into this realm of investigation. Moreover, given the fact that artifact collecting and pothunting have reduced or depleted culturally/temporally diagnostic materials from many sites in this region the need for this line of investigation is becoming increasingly critical.

Chapman's (1982) study is not an isolated situation and reflects a growing interest in the examination of cultural-temporal variability through lithic analysis. Preliminary studies focusing on technological organization in lithic assemblages have been conducted by Vierra (1980a), Schutt (1980) and Chapman (1977) for the Archaic and Anasazi of northwestern New Mexico. One operational assumption (hypothesis) guiding these investigations centered around mobility parameters. That is, since the Archaic represents a mobile hunter-gatherer cultural adaptation, and the Anasazi represents a sedentary agricultural system, each should reflect different forms of technological organization. Vierra's (1980a) study isolated differences in lithic material selection, flake length for use, an emphasis in biface production and use in the Archaic, and a predominance of handstones and milling stones in the Archaic versus manos and metates in the Anasazi. Schutt (1980) showed that there was a statistically significant difference between flake-to-angular debris ratios which could not be explained by material type or reduction stage alone, and that it may be related to variability in manufacturing techniques. Vierra (1980a) also notes possible differences in intra-site spatial organization which relates to the Archaic versus Anasazi cultural systems. These hypotheses, in addition to new hypotheses concerning the identification of aceramic sites, could be tested on samples from the Abo project area.

5.2.2.2 Site Location and Settlement Patterns

Understanding the factors which affected site location for the prehistoric occupants of the study area is an important problem; one that should be examined from a regional perspective. The Southwestern Archaeological

Research Group (SARG 1974:110) advocates a more productive systematic approach when stating that:

> Sites are components of settlement systems, and ultimately cannot be explained as entities in themselves. Relationships among components of a system and the system's natural and social environments cannot be explained without reference to the entire system of which the components are a part.

Binford (1983:109-143) has addressed the problems of settlement pattern and site location from an ethnoarchaeological perspective. He has identified an occupation system that presumably has validity for the Abo area. This includes a hierarchial set of sites, site complexes, territories and lifetime cycles.

Settlement pattern studies can act a conceptual framework and as a method for testing ecological and locational oriented hypotheses. Moore's (1980) study of the Archaic in northwestern New Mexico suggested floral diversity, seasonality, and water availability as factors. Grady's (1980) work in northwestern Colorado also noted water and vegetation, with topography as another factor. Grady (1980) also addresses the relationship between man and artiodactyls as a determinant of site location. This latter perspective (i.e., the relationship between prehistoric populations and game animals) should provide a particularly fruitful avenue of research applicable to the Abo project area cultural resources. For example, seasonal movement of bison and other game animals from winter to summer ranges and daily movement from feeding areas to watering locations presumably greatly affected the location and density of hunting-related sites, as well as the location of camps and processing sites.

Other models and techniques for understanding site location include the vegetative diversity model (Reher and Witter 1977; Chapman 1979), gravity flow model (Jochim 1976), and catchment analysis (Vita-Finzi and Higgs 1970; Chapman 1979a; Grady 1980). The distribution and variability evidenced by the cultural resources in the study area is conducive to the examination of site location from these various perspectives. When conducting ecologically oriented settlement pattern studies, archaeologists cannot assume that the past environmental variability was the same as that of the present. Therefore, paleoclimatic work must to be done before we can fully understand and explain the patterning preserved in the archaeological record. A number of hearths were documented in the project sites. These features typically contain macro- and micro-floral materials which can be incorporated into a study of the past environmental settings of the project area. Also, pack rat midden deposits occur in the project area which may potentially provide similar information. Other relevant paleoclimatic investigation might include studies of alluvial geomorphology and palynology.

5.2.2.3 Site Structure and Formation

While settlement pattern studies provide data at the inter-site level, studies relating to the settlement system (i.e., the functional components of the

settlement pattern (Winters 1969:1110) are viewed at the intra-site level. Site structure studies (Binford 1983:144-192) can provide data to aid in the determination of site function as it relates to the settlement system, and to the problems of group size, social structure, and organization, length of site occupation and reuse of particular locales. Site structure can be evaluated by several techniques including artifact distributions, multivariate statistics, and the behavioral organization and use of space (Binford 1983). Vierra (1981) was able to identify a possible Archaic campsite behavioral module from artifact distribution (i.e., isopleth) maps. The module consisted of a multi-functional activity hearth locus (including milling activities, tool use, and lithic reduction), and a lithic reduction locus (Vierra 1981a).

This pattern appears to be duplicated at a number of sites within the Abo study area. The number of intra-site loci identified during this survey and the internal integrity of many of the project's sites indicates that critical information regarding site organization and formation processes is preserved in the archaeological record of this area.

Multivariate statistics allows a numerical rather than an intuitive means of isolating covarying and associated tool groups. Factor analysis (Binford and Binford 1966, 1969) and principal component analysis are examples of this. Multivariate statistical methods could be applied to artifact assemblages from the Abo project area as well as the surrounding vicinity in an attempt to isolate covarying tool groups and form a basis for the generation of a more accurate site typology than currently exists. The information obtained during the Abo survey could be employed to develop a preliminary data base from which to initiate this type of study.

The organization and use of space can be observed through discard behavior (Binford 1978, 1983; Murray 1980). Chapman (1979, 1980) and Camilli (1979b) have used this method to describe artifact distributions and the organization of space on Archaic sites in central New Mexico. The apparent structural integrity of many of this project's sites (e.g., the numerous sites with multiple loci or discrete patterning of artifacts and features) indicates that this should be a fruitful avenue of investigation in the Abo region.

The problems of group size and length of occupation and reoccupation are also important issues for hunter-gatherer archaeology. Yellen (1977) and Binford (1983) have dealt with the problem from an ethnoarchaeological perspective and Chapman (1980) archaeologically. Yellen generated a set of formulae for determing group size by calculating the mean observations of !Kung Bushmen campsites. However, these are only empirical generalizations, and they do not explain what is conditioning site structure. Yellen (1977:81-82) makes an important observation involving site formation processes and the length of site occupation when he notes that with an increase in the length of occupation at the site there is an increase in site size and number of activities. Binford (1983:144-192) provides information regarding the use of space by social units of different size from a more cross-cultural perspective incorporating observations from a variety of ethnographic situations. His investigation indicates that the amount and distribution of debris at a site is influenced by a multitude of factors not necessarily related to the size of the social unit. These include the constraints of space, nature

and intensity of differing activity sets, cleanup strategies, and seasonality, among others.

Chapman (1980) attacked the group size problem through multi-hearth sites and determined whether they represented one occupation by a large group or multiple occupations by small groups. One analytical variable examined by Chapman was the distance between hearths as a reflection of spacing behavior between commensual units (i.e., the need for social and physical space). He proposed that sites reoccupied by one or two units should exhibit a minimum distance between hearths and that single episode sites occupied by several units should exhibit a maximum distance.

One problem with Chapman's study is that it does not take into account multiple hearths per group, hearth functional variability, and other factors (e.g., see Binford 1983:156-170). Chapman's attempt to understand multi-hearth, multi-loci sites was also done without any available radiocarbon dates. The contemporaneity of multiple loci at a site can be determined through the use of radiocarbon dating. Mueller and Stiger (1981) used this method to define temporal variability in site function and location for multiple loci Archaic sites in west central Colorado. Vierra (1980c) also used radiocarbon dates to assess a multiple locus site to be palimpsest.

The thermoluminescence dating of heated quartz-bearing rocks (e.g., sandstone, quartzite) may be an additional technique for dating project sites (Sutton 1980). A number of hearths present at many of the sites recorded in the study area should provide datable materials useful for definition of intra-site organization or identification of palimpsest sites. Future investigations should utilize hearths in an attempt to isolate single component sites or loci. This information could then be applied to testing projectile point or ceramic sequences and lithic technology variability through time.

More work needs to be done in all these areas by developing methodologies for interpreting the archaeological record (i.e., middle range research). At the present time there appears to be a sampling bias towards large reoccupied sites in cultural resource management mitigative programs. This may stem from the conceptualization that there is more retrievable information from these sites than from single component sites. On the contrary, single component sites will probably provide a clearer picture of the range in functional variability due to the lack of reoccupation and subsequent mixing of assemblages. Therefore, sampling designs should include the full range of possible site variability (Vierra 1980b:356). The study area can serve as a data base for testing these methodologies and hypotheses.

5.3 IDENTIFICATION OF SIGNIFICANT DATA VALUES IN THE ABO RESOURCES

5.3.1 Background

Critical to evaluating the NRHP significance of cultural resources is the understanding that they are "measurably and demonstrably finite, nonrenewable, and diminishing as a function of our society's use of the land" (Scovill,

et al. 1977:46). Scovill, Gordon and Anderson (1977:56) have recommended that, for National Register nomination, significance should be evaluated in terms of historical, scientific and social values. These values are not mutually exclusive (Scovill, et al. 1977:57). Archaeologists assess the cultural resources by their potential for providing information relevant to current professional goals. This includes a variety of research questions in such problem domains as cultural history, cultural ecology and cultural processes.

Both the National Register and a previous BLM cultural resource rating system (Hauck 1979a:132,133; 1979b:141,142) emphasize as a criterion the potential of an archaeological site to yield significant scientific information. As stated by Scovill, et al. (1977:62):

> Archaeological resources can be expected to possess significant data that are potentially important to the study and understanding of the past, most archaeological resources within the area of a proposed action's potential environmental impact will be found to possess sufficient significance to be eligible or potentially eligible for inclusion in the National Register.

King, et al. (1976:231) go on to note that:

> Archaeological properties do not have to be large, impressive, or rich in artifacts or data to qualify for the National Register, nor do they have to be suitable for public interpretation. Any archaeological resource is potentially eligible if one can legitimately argue that it is likely to be associated with a cultural pattern, process, or activity important to the history or prehistory of its locality, the United States, or humanity as a whole, provided its study can contribute to an understanding of that pattern, process or activity.

This is reiterated by Talmadge and Chester (1977:12):

> [We] ... must not a priori dismiss as insignificant or uninteresting, whole classes of archaeological sites and data simply because they may be difficult to study or be unprepossessing in form.

Every site is potentially significant given the proper research orientation and concern. They all have the potential to yield information important to the interpretation of some aspect of the past whether specific or general. As Frison (1978:15) states:

> Every site is unique and requires a specially formulated research design. Unfortunately there is no written source the archeologist can fall back upon to tell him exactly how to investigate a site. Methods of recovering and recording archeological data are continually changed and hopefully improved by innovative investigators.

5.3.2 Specific Values and Examples

Since a criterion for NRHP eligibility is the ability of a cultural resource to yield information important in prehistory or history we must first identify the critical information needs of the study area. We can then evaluate the potential for a site to address these needs and thereby begin to gauge its potential significance. What general research questions are considered apropos to the Abo study area? The work of Jelinek (1967), Kelley (1966), Speth and Parry (1978, 1980) and Speth (1983), among others, has provided a springboard from which to launch further efforts toward understanding the prehistoric record of the Abo study area. However, when viewed from a perspective relative to much of the rest of the Southwest the Abo study area remains, archaeologically speaking, terra incognita. The question of chronology was one of the earliest problem domains recognized by Southwestern prehistorians (e.g., Nelson 1919). While this has been more or less realized in many parts of the Southwest the chronology of the Abo study area remains poorly outlined and more poorly understood. Another primary research domain long recognized by southwestern scholars concerns the identification and definition of subsistence and settlement systems (e.g., Steward 1937:99-100; Haury 1956). Again, our understanding of this basic research domain in the Abo area is superficial at best and in serious need of more intensive investigation. There are additionally a variety of related research questions which extend from, and beyond, the basic problem domains of chronology and subsistence-settlement dynamics. These include questions regarding origins, ethnic identity, territory, demography, social organization, political structure, environmental adaptation and change related to environmental or social stress, as well as a variety of others.

The previous section of this chapter identifies a series of problem domains considered particularly appropriate to the investigation of the Abo study area cultural resources. This section articulates the previously identified problem domains (research domains) with the kinds of data (analytic elements) and the kinds of analytic strategies or techniques (analytic treatments) that would ultimately provide answers to questions pertinent to the various problem domains, and are listed in Table 5.1. In management terms vis-a-vis NRHP significance, the problem domains represent potential values, the analytic elements represent the actual, identifiable scientific data values that render the cultural resources significant. The analytic treatments represent the extraction of these values form the resources; i.e., mitigation.

The information presented in Table 5.1 is considered a relatively basic set and by no means exhausts the potential analytical elements, problem domains or analytical treatments that might be applied to the Abo area resources as a whole. However, it does provide a base from which to initially evaluate the information potential of a series of examples from the Abo survey site inventory.

Table 5.1
Analytical Elements, Research Domains and Analytical Treatments Appropriate to the Identification of Information Values for the Abo Survey Cultural Resources

Analytical Element	Research Domain	Analytical Treatments
1. Lithics	Chronology	Diagnostic artifacts; Weathering/oxidation/ patination; Technological attributes
	Site function	Assemblage characteristics; Debitage attributes
	Activity sets	Assemblage clusters
	Subsistence	Food procurement and processing tools
	Mobility	Material types; Assemblage characteristics (i.e., curated vs. expediency tools)
	Social organization	Microstylistic attributes
	Lithic technology	Reduction trajectories; Debitage attributes; Tool morphology
2. Ceramics	Chronology	Diagnostic local wares; Diagnostic intrusive wares; Style
	Site function	Vessel attributes (type, form, size)
	Activity sets	Assemblage clusters
	Subsistence	Vessel attributes
	Social organization	Ceramic types; Design elements; Paste, temper attributes; (sociotechnic attributes)
	Religion/ritual	Design elements; Vessel form; (ideotechnic attributes)

Table 5.1 (continued)
Analytical Elements, Research Domains and
Analytical Treatments Appropriate to the Identification
of Information Values for the Abo Survey Cultural Resources

Analytical Element	Research Domain	Analytical Treatments
2. Ceramics (continued)	External relations	Intrusive ceramics; Paste, temper attributes
	Ceramic technology	Paste, temper attributes; Production techniques
3. Modified Faunal Remains (e.g., shell beads)	Chronology	Diagnostic artifacts
	External relations	Imported artifacts
	Social organization	Sociotechnic artifacts
4. Faunal Remains	Chronology	Extinct vs. extant species; Carbon-14 materials
	Site function	Assemblage attributes (e.g., degree of modification)
	Subsistence and stress	Assemblage content; Processing techniques
	Seasonality	Assemblage content; Age structure
	Environmental reconstruction	Assemblage content
5. Hearth Features	Chronology	Charcoal for Carbon-14; Quartz-bearing rock for thermoluminescence; fired clay lining for archaeomagnetic
	Site function	Feature attributes (i.e., size, content, form, associations)
	Subsistence	Feature content and associations

Table 5.1 (continued)
Analytical Elements, Research Domains and
Analytical Treatments Appropriate to the Identification
of Information Values for the Abo Survey Cultural Resources

Analytical Element	Research Domain	Analytical Treatments
6. Rock Ring Features	Chronology	Temporally sensitive (?) "tipi rings"
	Site function	Feature attributes and associations
	Social organization	Feature size and number
7. Site Structure	Site function, Organization of space	Spatial analysis of artifacts and features
	Activity sets	Spatial associations
	Group size, Social organization, Occurrence and duration of occupation, Seasonality	Number, age and spatial distribution of features and artifacts
8. Stratigraphy (vertical and horizontal)	Chronology	Superposition of artifacts; Soil horizons
	Diachronic adaptation	Superposition of assemblages
	Environmental Reconstruction	Geomorphology; Palynology; Soil chemistry

As indicated in Table 5.1 analytical techniques that are potentially applicable to the Abo sites include methods oriented toward eliciting information pertaining to chronological, behavioral and environmental reconstruction. Obtaining information relevant to the prehistoric chronology of southeastern New Mexico is a major research objective. This might be realized through analysis of potentially diagnostic or culturally-temporally sensitive artifacts (e.g., projectile points, ceramics) or features (e.g., dwelling remains); recovery and processing of organic remains for biotic analysis and Carbon-14 dating, archaeomagnetic dating of hearths or other burned features, thermoluminescent dating of quartz-bearing rock from hearth features; investigation of the technological attributes of the reduction trajectory, use, material selection and

morphology of lithic artifacts; as well as analysis of the relative degree of weathering or oxidation on lithic artifacts; and geomorphological interpretation of the site setting and stratigraphy.

We currently know very little concerning the synchronic and diachronic dynamics of the cultural groups which occupied southeastern New Mexico in the prehistoric and protohistoric past. Interpreting the behavioral implications of the cultural resources constitutes another important avenue for future research. This includes determining the function(s) of the site, the size, composition and organization of the group occupying the site, and the number, nature and duration of occupation(s). This information can then be applied to ascertaining the placement of the site within a larger subsistence-settlement frame. Techniques which may be applicable to the investigation of this problem domain include analysis of the functional implications of the artifacts (e.g., stone tool morphology, edge angle and wear pattern studies; debitage studies; vessel form, paste, temper and stylistic analyses of ceramics); analysis of feature function (e.g., flotation recovery and identification of floral or faunal materials from hearth features coupled with examination of feature size, composition, setting and evidence of re-use); identification of activity sets and spatial organization of activities or site structure (e.g., analysis of the horizontal and vertical distribution of artifacts and features, through isopleth mapping and other association or spatial analysis techniques); identification of social group composition and organization through site structure analysis coupled with chronological data, feature analyses (e.g., size and type of structure), and artifact analysis; identification of mobility parameters through lithic material source analysis, ceramic source analysis, or faunal studies; investigation of the subsistence orientation through artifact studies, analysis of recovered faunal and floral remains (obtained through excavation or flotation), palynological analyses (e.g., of soil samples, feature fill), and contextual analysis (i.e., the location of the site relative to potential agricultural land, bison procurement or other subsistence related resource).

Another important avenue of investigation that should be considered prior to the implementation of a mitigation program is the reconstruction of the environmental setting of the site. That is, what was the environment of the area like when the site was occupied? This can potentially be realized through analysis of the geomorphological setting and depositional sequence or stratigraphy of the site (e.g., the identification of past climatic situations or temporally sensitive soil horizons); analysis of recovered faunal or floral remains; palynological analyses of soil samples or feature fill; and analysis of the site setting relative to the distribution of plant, animal and water resources (e.g., is the site located near a potentially active although now extinct water source, or does it contain features such as bedrock mortars in an area where mesquite or oaks do not occur today?).

This discussion (and Table 5.1) does not constitute a thorough or encompassing assessment of the potential kinds of analysis that might be applicable to realizing the information values of the Abo study area sites. Additional analytical techniques or methodologies should be anticipated. For example, these could include analysis of human skeletal remains (physical anthropology, paleopathology), analysis of structural remains (e.g., pithouses, surface

rooms), analysis of preserved feces (coprolite studies), and analysis of rock art execution, style, weathering, and distribution, among others. The ultimate analytical techniques required for adequate investigation of a cultural resource will be dependent upon the content and integrity of the site under investigation. The following section provides some examples from the Abo survey site inventory.

A set of sites from the Abo survey inventory are utilized as examples of the variability in the kinds and amount of information values manifested by the cultural resources. Variability in the information potential of the cultural resources in the Abo study area will directly affect the levels of effort required for mitigation. Therefore, along with the discussion of information potential is an evaluation of the levels of effort required to realize that potential. The amount of information potential will be dependent on the size, depth, content, complexity, and integrity of the cultural resource under investigation. The nature and intensity of the information potential, and ultimately mitigative effort, is best viewed as a continuum from minimal to substantial and may include a series of successive evaluative phases.

LA 45457 is a relatively small (700 square meters) lithic scatter identified as a Type 3C lithic procurement-workshop locale. It consists of a relatively sparse scatter of stone tools, cores and flakes situated on a residual deposit of lag gravels. The significance of this site lies in its potential for providing information relevant to the problem domains associated with analytical elements 1 and 7 in Table 5.1. Analyses could be focused toward eliciting information regarding aboriginal land-use strategies (i.e., how did the site function in a large settlement-subsistence system?). It would require investigation of the reduction technology employed in tool manufacture, material selection, functional parameters and location of tool use or manufacture. Minimally, we would want to determine what activities were conducted at this locale and what kinds of tools were manufactured which may have been removed for use elsewhere. Recommended mitigation procedures for this site would be restricted to surface collection in combination with point provenience mapping and followed by analyses of the collected materials. The depositional setting of this locale indicates that the site is entirely a surface manifestation thereby negating the need for subsurface testing or excavation.

Another small (630 square meters) lithic scatter site, LA 45471, is identified as a Type 4E limited activity locale (Figure 3.39). The surface manifestation of this site is relatively sparse and includes roughly 22 flakes and one stone drill. However, the depositional setting of this site on a broad alluvial stream terrace (Arroyo del Macho floodplain) may mask a more substantial buried cultural deposit. The information potential of this site is similar to that outlined for LA 45457 (i.e., applicable to the problem domains associated with Analytical Elements 1 and 7). However, it is enhanced by the strong potential for yielding subsurface deposits and is thereby applicable to the problem domains associated with Analytical Element 8 as well. For example, if present the subsurface deposits could contain information important to temporal and cultural identification, functional interpretation, subsistence, environmental reconstruction, change through time and a variety of other potential research questions. Therefore, the recommended mitigation procedures would include a testing and evaluation phase designed to determine the

presence or absence of a buried cultural deposit and, if present, to determine the depth, nature and extent. This testing could include the excavation of a series of test pits systematically placed across the site area. The excavation would coincide with a controlled collection and point provenience mapping of the surface artifacts. If the test excavations indicate that there are no buried cultural materials, then analysis and reporting of the collected artifacts, test procedures, and analytical results would effectively constitute the depletion of the site's significant data values. However, if buried cultural remains are present a more intensive mitigation program would need to be developed. The scope and intensity of the additional investigation required would be dependent upon the results of the test excavations. The greater the depth, size, complexity, and newly discovered information potential of the cultural deposit the greater the level of effort required for mitigation.

A similar phased mitigation program would be applicable to LA 44867, a relatively small sherd and lithic scatter site with an associated fire-cracked rock scatter. It is a Type 2B temporary camp characterized by two discrete loci with similar assemblages (Figure 3.35). One of the loci is located in a sandy setting with a potential for buried deposits. The other locus is located nearby in a basin-like hardpan setting with little readily apparent depth potential. The significance of this site lies in its potential for providing information relevant to the problem domains associated with analytical elements 1, 2, 5, 7 and 8. This includes problems related to the Formative period occupation of the region including chronology, site function and placement in a regional settlement-subsistence frame, subsistence, lithic and ceramic technology, social organization (i.e., group size, composition) and environmental reconstruction. Mitigation of this site could be accomplished through a surface collection and point provenience mapping program in concert with a testing phase. Testing would entail excavation of a series of units systematically placed across the site. The testing should be oriented toward determining the depth potential of the two loci and to determine if the two loci are in fact spatially segregated (i.e., not joined by subsurface deposits). If no subsurface deposits are encountered then analyses and reporting of the collected materials, methodology and analytical results would effectively constitute mitigation. However, if testing demonstrates the presence of buried cultural deposits then a more thorough excavation program would be required. The intensity and nature of investigation necessary for mitigation would be dependent upon the test results.

LA 44892 is a large (32,736 square meters) aceramic Type 2C temporary camp. The site contains abundant lithic artifacts and more than 29 fire-cracked and burned rock hearth features and is situated in an area of rolling coppice dunes (Figures 3.26 - 3.28). The information potential of this site is considered extremely high. The diversity in the lithic assemblage, the potential for vertical and horizontal stratigraphy, the large number of hearth features and the areal extent and complexity of the site are relevant to the problem domains associated with Analytical Elements 1, 3, 7 and 8. This could include investigation of the temporal-cultural placement, settlement placement (i.e., function within a larger settlement system), subsistence system, and organization and structure of the resident group(s). The placement of this site relative to a similar (though ceramic) site (LA 2707)

nearby enhances its potential for the examination of regional settlement and temporal change. The abundance of cultural debris, multiple hearth features and the coppice dune setting (potential buried deposits) are sufficient evidence to indicate the need for a relatively intensive mitigation program. As a minimum this should include a well developed sampling program encompassing detailed mapping and controlled surface recovery of the artifacts, intensive excavation of a series of hearth features and adjacent areas, less intensive sampling at additional localities, environmental studies (e.g., dune development), and thorough analyses, interpretation and reporting of the recovered materials and methodology.

The levels of effort required for site mitigation are not exhausted through excavation or surface recovery alone. The need for concomitant analysis, interpretation, and reporting of the recovered materials, and methodology, constitute integral aspects necessary for realizing the information potential of a site and for completion of the mitigation process.

LA 45459 is another examples of a relatively complex site with a high information potential. It is a moderate size site (12,075 square meters) characterized by a relatively dense lithic and sherd scatter with eight hearth features, an abundance of bone, and a strong potential for buried cultural deposits (as evidenced by erosion rills). Its information potential is relevant to the problem domains associated with Analytical Elements 1, 2, 4, 5, 7, and 8. This could include investigation of the temporal-cultural affiliation, settlement and subsistence strategies, seasonality, and social organization. This site occupies a unique place in then Abo site inventory. It appears to represent a bison (as evidenced by bone size and teeth) processing locale utilized during or following the Late Roswell phase. There is a deposit of large mammal bone (Bison?) eroding out of an arroyo cut in the floodplain of an ephemeral drainage several hundred meters from the site. This may represent the kill locus associated with the site. Also, a dense lithic scatter site, (LA 45458) with a number of fire-cracked rock hearth features is nearby. This site also contains bone and may represent an earlier or later (aceramic) use of the area for activities similar to those conducted at LA 45459. The potential significance of this site is enhanced by recent investigations at the Garnsey site (LA 18399; Speth and Parry 1978, 1980; Speth 1983).

The Garnsey site is a bone bed and sherd and lithic deposit identified by bison bone eroding out of an arroyo cut. Diagnostic artifacts (projectile points, ceramics) and Carbon 14 dates place its occupation during the mid to late fifteenth century. Based on faunal analyses and stratigraphy it has been interpreted as the result of reoccurring spring-season bison procurement and processing activities characterized by highly selective procurement and processing strategies (Speth 1983).

Lithic material analyses indicate that there was a change in settlement location during the course of the site's use. This involved a gradual shift further and further to the west of the Pecos Valley of the spring-season settlements from which hunters were going to the Garnsey site (Speth 1983:40,41). Lithic material analyses also indicated that during the earlier use of the site the mobility parameters of the occupants included the Texas Panhandle (at

least 300 - 400km east and northeast) or contact with groups resident there. In addition, the occurrence of obsidian in the same level as much of the Texas material indicates travel to or contact with groups 100 - 140km to the west, northwest, or southwest (Speth 1983:38).

Faunal studies at the Garnsey site indicate that the prehistoric procurement strategy involved the deliberate pursuit of males, and that the male bison were more intensively utilized than the females. This pattern indicates the Garnsey site procurement strategy was "operating within the context of at least some food insecurity, that was directed toward optimizing the yield per animal killed while at the same time minimizing bulk" (Speth 1983:167). Other studies (including Carbon Isotope analysis of bone) indicate that the local bison population was experiencing stressful conditions. Speth (1983:169) notes that:

> The Garnsey case by itself is insufficient to discriminate clearly between occasional or seasonal food shortages affecting only local populations and more continuous, endemic food insecurity in the mid- to late fifteenth century affecting populations over a much wider area of the Southern Plains.

As Speth (1973:170) further notes that there is a critical need for careful comparisons:

> It seems likely that exploitation of bison in the area would of necessity have been opportunistic, with frequent recourse to other hunted, gathered, or perhaps cultivated or traded resources. Ultimately, careful comparisons among a broad range of late prehistoric settlement types in the region are needed, in conjunction with far more detailed paleoenvironmental reconstructions, in order to delineate the nature, degree, and spatiotemporal extent of food stress affecting human adaptations during this critical and fascinating period of Southern Plains prehistory.

LA 45459 is an ideal site for comparison with Garnsey. The problem domains and many of the investigative techniques employed at Garnsey are applicable to LA 45459. One significant difference is that rather than being a kill-butchering-processing locale, LA 45459 appears to represent a site where secondary processing of butchered bison units occurred. This indicates that within the context of a settlement-subsistence system LA 45459 may represent a site complementary to that represented at Garnsey. For example, Speth (1983:160) notes that at the Garnsey site the bison were butchered and processed for transport to settlements that were probably to the west of the Pecos Valley. LA 45459 appears to represent a locale to which the processed bison units were taken for more intensive processing. As noted previously, the kill, butchering and initial processing component in the LA 45459 "site complex" (Binford 1983:117) may be indicated by the arroyo cut bone deposit. The setting is somewhat similar to Garnsey and may be characteristic of a particular hunting strategy, season, or both. The hearth features and density of cultural debris indicate that LA 45459 represents a palimpsest site characterized by multiple use episodes. This could be tested by dating the

hearth features. Also, there are two distinct hearth types present; large stone roasting pits and small camp fires. This may be indicative of changing site function or processing techniques, or the spatial segregation of different contemporaneous activity sets. This could also be tested by dating the hearth features coupled with analysis of their construction, content, and associations. Another important research question concerns the methods of processing. At LA 45459 the faunal remains are characterized by an abundance of small bone splinters, possibly the result of bone boiling or rendering of bone grease. Also the rock hearths are indicative of roasting relatively large quantities. Are these processing techniques characteristic of a particular response to abundance or stress, are they seasonally specific, and are they characteristic of a particular site type (e.g., a camp locale in close proximity to a kill locale)? Analyses of the faunal remains and features coupled with investigations at similar sites will be necessary to address these questions.

The level of effort required to realize the information potential of LA 45459 should entail a systematic surface recovery and excavation program. This should minimally include investigation of a series of the hearth features, excavation of blocks of area associated with both hearth types and other areas spatially segregated form the hearths. Analyses should include processing of datable materials, faunal studies, lithic and ceramic studies and analysis of spatial associations and possibly carbon isotope analysis of bone.

LA 45484 (Figure 3.19) is a large Type 1D multiple use locale situated in the eastern portion of the study area. Investigation of this site could yield data pertaining to the problem domains included with Analytical Elements 1, 2, 4, 5, 7, and 8 in Table 5.1. LA 45484 has a strong potential for addressing chronological and culture history problems. This is evident by the presence of multiple loci containing ceramics or hearths with potential dating materials. Also, there is a good possibility that diagnostic projectile points would be recovered during excavations at this site. One of the locales (Sample Transect 2) monitored at this site contained an assemblage that is often associated with projectile points and had a pinflag present. It is highly probable that this locus (and perhaps other portions of the site) has been surface collected in the past. The impact of this collection might be ameliorated somewhat by contacting local collectors (or perhaps local archaeologists) in an effort to locate any collected materials for analysis.

Furthermore, there exists a strong potential for buried deposits which may contain temporally or culturally diagnostic materials or datable remains in a vertical stratigraphic relationship. In addition, the broad distribution of cultural materials throughout this site, particularly the differential clustering of cultural debris lends itself to analysis through horizontal stratigraphy.

The content and integrity of this site is potentially important for addressing a variety of behavioral issues. The site is considered a palimpsest locale used through time for a variety of purposes. By investigating the differences in the content, density, and distribution of cultural materials between these loci, aspects of the prehistoric land use strategies and intrasite organization can be identified. Concomitant with this is the potential for evaluating subsistence pursuits and seasonality, at the different loci (e.g., through

artifact and features analysis, analysis of floral, faunal and palynological remains); estimating group size and composition, and duration of occupation at the different loci (e.g., through site structure or spatial analysis, feature analysis and analysis of assemblage size and composition); mobility parameters (through lithic source material studies); and examining the changes in the use of this area through time (e.g., based on stratigraphic relationships and temporally diagnostic artifacts).

To adequately realize the information potential of a site of this size (ca. 400,000 square meters) would require an extensive and intensive surface recovery and excavation program accompanied by a battery of analytical techniques. This is one type of cultural resource from the Abo area that creates some serious problems for mitigation. The majority of impacts in this area are typically relatively localized (e.g., well pads over approximately four acres, and pipelines and access roads cut narrow linear swaths through the landscape). What is the most appropriate strategy for mitigating the effects of a well pad, pipeline and access road within a site like LA 45484? A program restricted to the areas of impact only would not be sufficient. The researcher would not be able to properly evaluate the areas thus represented. That is, the entire site must be evaluated to put the impact zones into perspective. On the other hand it is not considered realistic nor appropriate to require a developer to fund an extensive mitigation effort far beyond the project confines. One potential solution is that the impact areas would receive relatively intensive investigation (e.g., Hunt 1983), concomitant with a program designed to identify the nature of the remaining site area. Presuming that the entire site has been adequately surveyed, this could be accomplished by the systematic placement across the site of sample transects (e.g., linear, areal; Figures 3.19 and 3.21; Eidenbach 1982:86,87) of sufficient size and distribution to provide a data base adequate enough to allow a realistic evaluation of the area of impact. This could not necessarily have to entail surface collection or excavation. Rather, intensive in-field recording of the nature and distribution of artifacts and features at the sample localities should be sufficient in most instances. There are conceivably other situations where more intensive investigation would be warranted. For example, obtaining a carbon-14 date from a hearth feature outside of the impact zone would substantially enhance the information value of the data within the impact zone. The critical concern is that information from cultural resources within the area of impact does not exist in a vacuum, as though it were isolated in space rather than part of the large, more complex situation. Placing the information values derived from the impact zone into the perspective of the larger phenomena enhances the identification of the values that are threatened and provides a sound basis for extracting them in an efficient fashion. However, it should be noted that the sampling of the larger site area would not constitute mitigation of the entire resources. Any additional impact action within the undisturbed site area would have to be evaluated vis-a-vis the remaining information values.

Chapter 6

MANAGEMENT RECOMMENDATIONS

6.1 RECOMMENDED PROCEDURES AND REQUIREMENTS FOR FUTURE INVENTORY

There is no basis in fact for the elimination or reduction of clearance-type cultural resources inventory requirements within any portion of the Abo oil and gas field. First, the analyses presented in Chapter 4 clearly demonstrate that insufficient information is currently available to reliably extrapolate site occurrence and location beyond the existing data. Additional inventory data, including both positive and negative observations, remains a critical need for the effective cultural resources management and planning within the Abo area. Additional data are clearly required in order to predict site location and incidence with acceptable levels of precision and accuracy. Given the fact that the existing site and no-site data base characteristics are similar to those estimated for the Abo area (see Table 4.16), it is likely that an additional 500 - 1,000 observations (surveys) will fulfill the necessary data requirements for reliable prediction and a legitimate basis for sound planning. Second, the site location models developed with the existing data base indicate that the least favorable odds for encountering a significant site in any portion of the study area is one in four. This first-approximation rate of site occurrence does not pass the "future inventory effort will be virtually fruitless" test set forth in the Romero-Barcello v. Brown (16 ERC 1593-1616) case which has subsequently been utilized by the Courts as a reasonable test of public agency responsibilities under the existing legislation and regulations.

Consistent with these mandates, cultural resources inventories in the Abo field where cultural resources are and will be potentially adversely affected by ground-disturbing activities, any and all significant resources (i.e., those places assessed to be eligible or potentially eligible for nomination to the National Register of Historic Places) must be identified and subjected to protective management. Third, the first-approximation distributions of the kinds of settings which are likely to contain sites as specified by the 10 models are evenly distributed throughout the entire Abo study area. Thus no "no effect" loci can be identified which do not warrant clearance-type survey. Although this study resulted in a first-approximation analysis only, there are sufficient data to fulfill current oil and gas related regulatory requirements [43 CFR 3160 III.E.] regarding the demonstrable need to perform cultural resources inventory survey on BLM administered lands. The distribution maps show that there is relatively high likelihood of encountering significant sites in all land jurisdictions which exist within the Abo study area and thus inventory surveys are warranted regardless of land jurisdiction status.

Based upon the results and experience achieved from the Abo sample survey, the existing literature and reports, discussions with colleagues and demonstrated needs of Roswell District cultural resources managers (Zale 1983), recommended minimal requirements for inventory within the Abo study area can be specified. Presented below is an outline which details these requirements from survey procedures through site recording. If these guidelines are systematically followed, the data generated will be appropriate for addressing the problem domains identified in Chapter 5, will meet regulatory standards, will meet data needs for planning, will greatly enhance decision-making needs regarding appropriate mitigative treatment, and will greatly reduce ambiguity and inconsistency in the data base.

RECOMMENDED GUIDELINES FOR CLEARANCE-TYPE CULTURAL RESOURCES SURVEYS WITHIN THE BUREAU OF LAND MANAGEMENT'S ABO GAS AND OIL FIELD, ROSWELL DISTRICT, NEW MEXICO

I. SURVEY PROCEDURES

A. Acceptable Survey Conditions

1. Lighting conditions must be sufficient for good ground visibility and resource detection within a 10-meter radius.

2. At least 60% of the ground surface must be visible and free of snow cover.

B. Spacing

1. An average maximum distance between surveyors (or transects if an area is being inventoried by one archaeologist) must not exceed 20 meters.

2. Subject to local ground cover and topographic conditions, spacing between surveyors or transects can vary from the 20-meter interval to ensure that all cultural resources have been accurately detected. Closer spacing and ground monitoring is recommended for those areas characterized by an abundance of lithic source materials (e.g., gravel deposits and in the limestone hill country).

II. NON-CULTURAL OBSERVATIONS

Since the survey data will ultimately be sent to the Laboratory of Anthropology and encoded into the ARM system, the following observations are required, whether or not any cultural resources were found.

A. Location of Survey Area

1. Legal Description - Township, Range, Section, ¼¼¼ section, USGS topographic map name, County, State

2. UTM Coordinates

3. Size (in acres) as well as length and width (in feet)

4. Location, size and shape of survey area as well as the location and areal extent of all cultural resources encountered must be accurately plotted on the appropriate USGS topographic map.

B. Environmental Setting

1. Topographic setting
   a. landform
   b. relief
   c. elevation
   d. aspect or exposure

2. Water Resources
   a. distance and direction to the nearest permanent water resource
   b. name of this resource
   c. nearest other potential water resources

3. Land Resources
   a. Geological substrate or formation
   b. Soil derivation (aeolian, alluvial, colluvial, residual, etc.)
   c. Soil composition (sandy, clayey, sandy loam, etc.)
   d. Availability of lithic resources, types present and distribution within the area surveyed.

4. Biotic Resources
   a. Vegetative community(ies) (grassland, mesquite-grassland, etc.) and its/their distribution within the study area.
   b. Plant species list
   c. Observed fauna or evidence thereof

5. Environmental Factors Influencing Cultural Resources Detection and Integrity
   a. Erosional factors
   b. Depositional factors
   c. Ground cover

6. Survey Performance Data
   a. Description of weather conditions
   b. Lighting conditions
   c. Ground visibility conditions
   d. Survey methodology including intervals and number of participants
   e. Person-hours expended during survey

III. CULTURAL RESOURCES PROCEDURES AND DATA REQUIREMENTS

A. Sites

1. Location (use all data categories specified in II.A. plus access data - how to get to the site and distinctive landmarks)

2. Environmental setting (use all data categories specified in II.B.1-5)

3. Site map, to scale showing:
    a. location of features
    b. diagnostic artifacts
    c. concentrations of cultural debris
    d. scale, north arrow, legend
    e. location of areas sampled
    f. site boundary

4. Site size (length x width and area in square meters)

5. Evaluation of site function (e.g., temporary camp, lithic procurement, limited activity, sedentary community, homestead, etc.). Based upon the analysis of the site types from the Abo sample survey, minimal observations which significantly differentiates behavioral variability includes the presence or absence of hearths/fire-cracked rock, milling equipment, non-angular hammerstones, ceramics, on-site lithic raw materials and drills/boring tools.

6. Site integrity (observed post-occupational environmental effects, vandalism/disturbance and extent)

7. Density and areal extent of cultural deposits (if sampled, the fraction sampled and sampling procedures must be identified)

8. Depth potential and evidence for subsurface deposits

9. Feature recording procedures
    a. Identification and description of each feature, including
        (1) size
        (2) content
        (3) location within site

10. Artifact Recording Procedures
    a. Lithic Artifacts
        (1) Tools - clear, concise descriptions of each tool type including size, numbers of each, material type. All diagnostic artifacts should be measured and drawn to scale, as well as representative examples of non-diagnostic tool types

        (2) Lithic Debitage - clear, concise descriptions of the types and numbers represented (e.g., primary flakes, secondary flakes, biface reduction flakes, etc.), cross-tabulated with size class and material type. Maximum density/square meter and estimated total number of artifacts for all lithics within the site is also required.

b. Ceramics - type cross-tabulated by number of sherds and vessel form. If the type cannot be determined, the paste, temper, surface treatment and decoration should be described. Maximum density/square meter and estimated total number of ceramics within the site is also required.

c. Historic - type, function, chronologically sensitive attributes (e.g., color of glass, brand names, etc.). Number and density of historic artifacts is also required.

d. Other Artifacts - description of other artifact types: bone/shell tools or ornaments, faunal remains (species, large or small species), condition, modification, number and relative amount, fire-cracked rock, other manuports.

11. Written description of the site including setting, cultural content and distributions, age, functional characteristics, and data potential.

12. Cultural/Temporal Assessment: For each component represented within the site, describe features and function, specifying as precisely as possible, the period and phase and the best date for each component. Also describe the method used for cultural/temporal assignment.

13. Archaeological Status: Document any previous work on the site, whether the site is on or was previously nominated for inclusion in the National or State of New Mexico Registers, is located within an Historic District of, if not previously assessed, whether or not the site is considered potentially eligible for nomination to the State or National Registers of Historic Places.

    If the resources have not been previously assessed, a number of minimal observations are required. First, the scientific, heritage or educational values inherent in the site must be identified. Second, how these values would serve to address major problem domains or would enhance our knowledge or appreciation of the past must be demonstrated. Third, if the site possesses any unique characteristics vis-a-vis scientific, heritage and/or education interests, these must be specified. Finally, recommendations regarding the future status of the site must be identified (i.e. avoidance, further testing/ evaluation, mitigation, or clearance to destroy the site without further assessment).

14. Archival and Curation Information: These data are essential elements for information storage and retrieval and must include the following:
    a. Name(s) of Recorder(s) and Date
    b. Organization performing the survey
    c. Title of report documenting this project
    d. Repository for site, photographic, report or other records
    e. If any artifacts were collected, provide a synoptic listing and where these materials are curated.

B. Isolated Occurrences

1. Location: Use all pertinent data categories (specified in II.A.).

2. Environmental Setting: Briefly described topographic setting, vegetative community and soils.

3. Description: Follow the procedures for artifact recording. If the locus contains more than a few items, draw a sketch map to scale. Assign function to the locus, if possible.

4. Cultural/Temporal Assignment: Follow the procedures described for sites.

5. Evaluation: There are data indicating that isolates may, in some cases, specify the location of a buried site in this region. Thus it is essential to demonstrate whether or not the resources are truly ephemeral. Analysis and description of the depositional/erosional setting and ground cover characteristics are therefore necessary to make this assessment. Following the assessment, recommendation regarding future actions are required (e.g. monitoring and further evaluation, or clearance).

6. Archival/curation Status:
    a. Name(s) of recorder(s) and date
    b. Organization
    c. Repository for records and reports
    d. If materials were collected, description and where curated.

6.2 RECOMMENDED TREATMENT OF PROBLEMATICAL RESOURCES IN THE ABO AREA

There are a number of resource classes in the Abo area which constitute real problems to both cultural resource managers and archaeologists attempting to deal with them. In some cases the problematical nature of these resources are cultural or behavioral phenomena; in others they are environmentally related. Since the Abo Class II inventory was a tract-type survey, some perspective regarding the recognition and treatment of these problematical resources has been acquired. Although further refinement of the recommended procedures is anticipated, the intent of these recommendations is to achieve methodological consistency and to maximize effective and efficient protective management.

6.2.1 Extensive Sherd and Lithic Scatters

As illustrated previously in this report, sites can range up to truly enormous size in this region. Based on the Abo survey data as well as previously recorded site information, two subclasses of areally extensive lithic or sherd/lithic scatters have been recognized. The first of these which is labelled Terrace or Gravel Use Areas occur along the Pecos and its major tributaries. These are invariably located on gravel terraces or lag gravel deposits, are linear in shape, and can literally extend for miles along these terraces. Based on areal extent and artifact density distributions, these large sites were undoubtedly utilized repetitively through time. They also exhibit the outcomes of a multiplicity of behaviors including lithic procurement, limited activity/tool use and multibehavioral encampment activities. An example of such a locus is shown in Figure 2.2.

A number of procedures for survey and recording Terrace or Gravel Use Area sites in the context of gas/oil development are recommended. First it is important that archaeological surveyors recognize the terrace or gravel deposit setting, for the width of the terrace or deposit will usually define the boundaries for the short axis of the site. Since these resource areas frequently extend for long distances and would entail far more effort that warranted vis-a-vis the proposed action, it is not considered essential that the entire locus be recorded, particularly if much of the site extends well beyond the area of adverse effect. Rather, it is recommended that priority be placed on recording a sufficiently large portion of the use area to ensure resource identification and protection vis-a-vis the proposed land disturbing activities. Further, it is recommmended that the arbitrary boundaries for the long axis of the resource area clearly show that the usage zone extends beyond them. Generally these sites are partitioned into segments by erosional channels or patchiness in the exposure of gravel deposits which are usually coterminous with cultural debris clusters. These characteristics are recommended for use as arbitrary boundaries for the long axis of such areas, for they are likely to capture behaviorally/culturally meaningful units within the area.

The second type of large lithic or sherd/lithic sites, labeled Non-Riverine Use Area are situated in a variety of physiographic/topographic settings,

particularly on hill tops and slopes, are more amorphous in shape, but again are areally extensive - often encompassing at least 40 to 80 acres of land. These areas were undoubtedly generated as the result of multiple occupations, although the range of activities represented at such sites can be relatively small. Again, the size of such sites would often entail more inventory and recording effort than warranted by the nature of the proposed land disturbing actions. Nonetheless, critical needs include the identification of a sufficiently large portion of the site to ensure appropriate protection, assessment, and recommendation vis-a-vis the location and extent of the proposed disturbance. The Abo Class II survey revealed a number of instances where insufficient survey had been performed, for well pads, pipelines and access roads were found well within the boundaries of such sites. Since many of these sites are composed of sets of relatively discrete clusters of artifacts and other features, it is recommended that a zone extending at least 100 meters from a cluster be intensively surveyed to adequately assess the areal extent of the site and the placement of the impact areas. If the site extends well beyond the areas of impact, the site maps must reflect that only a portion of the site has been recorded, but that sufficient survey has been performed to adequately assess and protect the resource.

The level of recordation effort recommended here could and has resulted in the assignment of multiple BLM and Laboratory of Anthropology site numbers to various portions of the same resource area that had been independently inventoried. To a certain degree this is unavoidable, although several procedures are recommended that would either reduce the number of independent listings, or would ensure that each portion of the resource area receiving a separate number would be effectively managed. First, it is essential that the archaeological surveyor(s) clearly indicate that the boundaries of the resource extend beyond the survey area and that the BLM resource managers note this fact on their master inventory maps. Second, it is recommended that the archaeologist(s) consult the BLM cultural resource inventory maps and data files, particularly when encountering areally extensive resources, to assess the possibility that previous surveys might have identified adjacent portions of the same resource. When this possibility is clearly the case, it is recommended that the new survey data be appended to the previously recorded site information and the existing site number be utilized to identify the combined resource areas. Both the BLM and the Laboratory of Anthropology are prepared to accept and revise their site records. In other instances, a case cannot be made for combining resource areas into a simple, areally extensive locus. Until sufficient data become available it is recommended that each resource area receive a separate site/resource identification number. Again it must be emphasized that sufficient data be collected, analyzed and assessed to ensure that the information potential of the resource is realized as fully as possible. This is regarded to be essential for the justification of a partial resource area as a management unit and for identifying the most appropriate mitigative/protective treatment for the area.

6.2.2 Limestone Hill Chert Lithic Scatter Sites: Recommendations for Defining and Recording

The San Andres Formation is a geological deposit formed during the Permian Period. It is composed of a series of stratigraphically superimposed members which are differentially characterized by limestone, dolomite, marine invertebrae fossils, gypsum, mudstone and sandstone (Kelley 1971). The Fourmile Draw Member of this formation occurs throughout the western portion of the study area. Associated with this dolomite/limestone formation are deposits of chert. The chert does not occur uniformly throughout the formation and varies substantially in local occurrence, abundance, and quality.

One of slated goals of the Abo project was to "develop recommendations for recognizing and defining chert lithic sites in limestone hill country" (BLM 1982:27). The chert occurs as nodules, chunks or angular fragments imbedded in the dolomite/limestone matrix and scattered about the surface as "float" material. The Abo survey data indicate that where good knapping quality chert (i.e. fine-grained, homogenous chert with well developed concoidal fracture potential) occurs in relative abundance it was exploited by the aboriginal inhabitants of the region. This activity has resulted in a variable distribution of lithic procurement and workshop detritus (flake debris, angular fragments, cores, core fragments, and various chipped stone tools in varying states of completion) throughout the area (e.g. LA 45454, LA 45493, LA 45495 and Sample Unit 8-23-22-3).

The inherent problem in dealing with these locales (and others where no human activity has occurred) is that some of the chert fragments appear culturally modified. That is, many chert nodules, chunks and angular fragments exhibit marginally retouched (predominately unifacial although some bifacial retouch is present) and crushed edges superficially similar to the modification exhibited on a well-used scraping implement; others have lightly retouched ("nibbled") edges that resemble use wear patterns often noted on utilized flakes; and still other chunks exhibit concave "flutes" and shallow areas that resemble negative flake scars. As a consequence a problem domain has developed concerning the identification of cultural artifacts versus natural "eoliths" or "geofacts" and ultimately sites versus non-sites. This is not a simple matter and is complicated at some locales by the co-occurrence of obviously cultural material and obviously natural material with other indeterminant possibly cultural, possibly natural, specimens. These latter artifacts tend to create a nebulous or "gray" area of artifact and ultimately site resolution (e.g., Ross 1973:27).

A common comment associated with these nebulous specimens is that "if you found one on a 'site' (i.e., one not in the limestone hills) you would have no qualms about calling it an artifact". However, the number and consistently reoccurring pattern of modification on the specimens and absence of other less nebulous artifact types indicate a probable natural origin. The Abo survey examined a number of sample units situated in the limestone hill country. Four of these units occur in areas where good quality chert was readily available and which evidenced use by aboriginal stone knappers. The intensity of use varied between and within these localities. Some (e.g., site

LA 45493 in sample unit 7-23-8-6) exhibit relatively intensive exploitation (215 artifacts per 100 square meters); others (e.g., LA 45495 and LA 45454) moderately light to very light use (e.g., 32 artifacts per 100 square meters, and three artifacts per 100 square meters).

Given the increased development anticipated to occur in the San Andres limestone hill country the BLM is in need of a set of guidelines for consistent evaluation of archaeological survey reconnaissance and site identification performance. The following suggestions are presented in an effort to expedite the problems inherent in the identification of these sites and their evaluation. First of all, given the differential nature of the use of this area by prehistoric populations and the inherent cultural-natural ambiguity in some of the lithic debris associated with the chert outcrops, it is recommended that survey reconnaissance be more closely spaced with more intensive ground examination than that required for other areas (e.g., rolling plains, dune fields, valley bottoms).

When examining individual specimens for artifact potential, researchers should ascertain whether they meet generally recognized criteria for identifying artifacts produced by human agency versus natural agency (e.g., flakes exhibiting striking platforms, bulbs of percussion, dorsal flake scars, etc; cores with negative flake scars; formally manufactured flake or core tools). However, it is emphasized that the examination of these locales should not focus on individual specimens. Artifact criteria studies and professional dialogue are common in the literature (e.g., Duvall and Venner 1979; Haynes 1973; Barnes 1939; Patterson 1983) and are replete with differing viewpoints.

Once the presence of cultural material has been identified (i.e., flakes, cores or other obvious products of human modification) at a survey locale, the surveyors should 1) conduct a series of systematic linear transects through the area in order to locate, identify and quantify cultural materials and the nature of their distribution and establish the extent of the cultural manifestation, or 2) establish a series of sample transects (square or circular) at regular intervals across the potential site area in order to capture the same set of information. These transects should be located on a map and the quantity and distribution of cultural material identified.

Assuming that material unquestionably of cultural origin has been identified at a specific locale, the primary recommendation for evaluating the potential designation of the cultural resource as a site, isolated occurrence or extensive "use area" is not to examine every specimen asking whether it is an artifact or not; rather does the locale under investigation satisfy a specific set of criteria for archaeological sites?

1. What are the size and density parameters of the cultural deposit?

2. Is patterning evident in the distribution of artifacts, i.e., can discrete artifact loci be identified?

3. Are there other features or artifacts (other than San Andres chert) present which would indicate use of the locale by aboriginal populations

for purposes other than lithic procurement (e.g., imported lithic materials, ground stone, hammerstones, hearths, etc.)?

4. Does the assemblage composition realistically reflect use of the locale for generally accepted aboriginal activities (e.g., lithic procurement; workshop or tool use activities such as woodworking, hide processing, etc.; or domestic activities including food processing, etc.)?

5. Does the assemblage contain a mixed group of artifact types (i.e., primary, secondary, tertiary flakes, cores, and chipped stone tools of various forms) rather than a repetitious set of similar "tools" with an absence of readily identifiable flake debris?

Once the presence of a cultural resource has been determined for a particular impact area (well pad, pipeline, access road) its nature and classification should be identified. If the resource is restricted to a very sparse scatter or cluster of limited numbers of artifacts then an isolated occurrence designation should be appropriate. If there are greater numbers of artifacts present in an identifiably bounded area with a "sterile" zone surrounding it then a site designation is warranted. These two types of cultural resources should then be documented according to standard BLM guidelines. However, if the cultural resource can be identified as a much more extensive phenomenon (e.g., large lithic procurement locale or general use area) then the same set of recommendations made in the previous sections for large, or extensive lithic or sherd and lithic scatters should apply.

6.2.3 Recommended Procedures Regarding Sites in Dunal Settings

Dunal settings were often preferred locations for sites in the Abo region. Two types of dunes occur in the study area: longitudinal dunes situated along streams, playas and at the base of escarpments, and coppice dunes in the mesquite shrublands. Sites occur in both types. Sites in dunal settings require special attention for the potential for site burial or partial burial is extremely high. It is impossible to achieve a 100% certainty that all resources in dunal areas have been found and their areal extent accurately identified without systematic subsurface testing. Nonetheless, a number of surface survey techniques can be recommended that provide a relatively high degree of assurance that all detectable resources have been identified and their areal extent determined. In coppice dune areas, the sandy deposits form mounds 60cm to 2 meters in height. These mounds often intersect forming patches of elevated terrain. Invariably, however, aeolian action has produced blowout basins and alluvial action has dissected the dune field with myriads of small runoff channels. It is in these zones of erosion that cultural materials are generally exposed. Because the eroded areas are frequently small, the number of cultural items exposed may be relatively few. Nonetheless, systematic transect coverage of the area accompanied by plotting and mapping of these items frequently results in the definition of one or more spatially discrete clusters. Thus the initial conclusion that the locus represents an ephemeral use area represented by a few isolated occurrences subsequently disappears in the context of observed spatial patterning. This procedure is therefore recommended for the detection of sites in coppice dunal settings.

Moreover, it is further recommended that systematic transects and map plotting be continued for a 75 meter radius around a discovered cluster to ensure that the areal extent and complexity of the site has been adequately determined. Based on field observations, it is clear that sufficient mapping had not been consistently performed, since oil and gas related impacts were located well within the boundaries of several sites in coppice dune fields.

Most of the longitudinal dunes in the Abo area are relatively small but usually showed evidence of prehistoric occupation and use. This evidence was usually in the form of artifacts exposed in deflation areas. The site recognition procedures utilized and recommended here were the same as those for coppice dunal areas. One example of a relatively long longitudinal dune was recorded by the sample survey. It too contained a site that extended beyond the boundaries of the sample unit. Thus site size and complexity may vary directly with longitudinal dune size in this region.

6.3 RECOMMENDED MITIGATION STRATEGIES FOR THE ABO AREA

6.3.1 Analysis of the "Site Pool" Concept in Mitigation Programs

The analysis of site type variability exhibited by the Abo cultural resources (see Chapter 3) clearly shows extremely high levels of diversity. The range of functional diversity as well as behavioral complexity manifested within these sites is also extremely broad. There is also evidence that the entire study area constituted a use area for a variety of human groups within any given period (see Chapter 4.3); thus site type variability appears to crosscut cultural-temporal variation. Given these circumstances, no meaningful set of criteria can be applied at this time to the resources within this region that would "pool" the sites into groups of identical sets of phenomena that could then be sampled in a region-wide mitigation program. Such an approach to achieving clearance for the Abo Field not only violates the concept of perpetual multiple land use, but is also infeasible. Nothing less than a testing/excavation program for *all* sites can be responsibly recommended at this time, given the diverse nature of the cultural resource and the multiplicity of problem domains which must be addressed (see Chapter 5).

The application of the "site pool" concept to testing/excavation programs has consistently and appropriately been narrowly focused by archaeologists onto relatively small sets of sites threatened by ground disturbing actions. When dealing with a small group of sites, the range of site type and cultural/temporal variability is invariably much smaller than that manifested within any given region. Similarly, the number of problem domains that can be addressed within a small set of resources is also finite. Since data needs are usually regulated by these problem domains, a small set of sites can be "pooled" and sampled to answer a particular set of questions. Virtually all archaeologists tacitly recognize that the outcomes from a particular mitigation program involving a relatively small number of sites can only satisfy the parochial interests of each investigator. Although these accomplishments clearly contribute to a better understanding and appreciation of the history or prehistory of a given region, *such programs do not, nor were they designed to be, a final and complete set of statements regarding the nature of*

the past within that region. Thus cultural resources truly are resources, to be identified, managed and used judiciously such that their heritage, educational and scientific data values can be extracted over a long period of time by numerous historians and archaeologists who collectively represent a diverse set of interests and who can collectively enhance the cultural environment of the public, a policy which is clearly set forth in the existing cultural resources legislation. It is therefore not only impractical and infeasible to implement a region-wide mitigation program on public lands in the Abo area, it is also illegal.

6.3.2 Recommended Mitigative Actions for Oil and Gas Activities in the Abo Field

In light of the foregoing discussion the most responsible, reasonable and feasible strategy for mitigating the adverse effects of ground disturbance to cultural resource in the context of oil and gas development in the Abo field is protective management. The most cost-effective and feasible mitigative treatment is avoidance of the cultural resources. The placement of well pads, access roads and pipelines are usually sufficiently flexible that avoidance of sites is the most reasonable and thus should remain the preferred mitigative alternative. This means that inventory surveys and assessments for each and every proposed ground-disturbing action would constitute the most cost-effective method for implementing this mitigative treatment.

Based on the evidence from the Abo Class II survey, however, there is reason to believe that the levels of resource detection in this region are somewhat low and additional mitigative treatments are warranted. The areal extent of some sites have not always been adequately defined and thus more intensive survey methodologies have been recommended to reduce resource loss due to survey inadequacy. There is also evidence that partially and completely buried sites exist in the Abo region. Criteria for the recognition of buried or partially buried resources have been specified in this chapter. Because the incidence of areally extensive sites and buried cultural deposits is relatively high, it is recommended that testing/evaluation procedures accompanied by monitoring of ground-disturbing activities be utilized in all instances where potential adverse effects to the cultural resources can be demonstrated. It is further recommended that full-scale testing/excavation mitigative treatments be applied only when avoidance or informed judicious placement of ground-disturbing actions is completely infeasible.

There are two levels of adverse effect that occur in the context of oil and gas activities: impacts which would virtually destroy all of the values manifested by the cultural resources, and effects which would deplete a portion of those values. Two basic strategies are therefore recommended to mitigate adverse effects when avoidance is infeasible. For those cases where severe or complete value losses are threatened, a full-scale data recovery program that would satisfy data requirements such as those specified in Chapter 5 (see Table 5.1 and the site-specific examples which follow) is recommended. For those cases where partial value losses would occur, a data recovery program which would satisfy data requirements related to those threatened values is recommended. Since the cultural resources in the Abo

area exhibit a wide range of significant information potential, and the range of impacts (particularly partial impacts) is also large, it is impossible to identify all of the kinds of site-specific mitigation strategies that could be encountered. Examples illustrating the range of information potential found within the most commonly encountered sites is presented in Chapter 5. The major levels of mitigative treatment and recommendations for expediting procedures are presented in the subsequent section.

6.3.3 Identification of Time, Effort and Administrative Parameters in Mitigation Programs and Recommendations for Streamlining

Operators holding competitive oil and gas leases on public lands have five years to drill their wells or otherwise forfeit their leases. Noncompetitive lessees must complete drilling operations within 10 years. Although cost and market conditions are the primary factors which govern when the leases will be developed, it would be both prudent and advisable that cultural resources inventory and assessment be conducted at least eight months prior to the lease expiration date to avoid undue delays in Notice of Staking (NOS) or Application for Permit to Drill (APD) approval by BLM. There are a number of reasons which underlie this recommendation. First, the Abo sample survey and the site prediction model (see Chapter 4) as well as the assessment of the significance of the Abo cultural resources (Chapter 5) collectively demonstrate that properties potentially eligible for nomination to the National Register of Historic Places are likely to be encountered anywhere within the Abo area. Thus sufficient information has been developed to demonstrate that there is:

> ...reason to believe that properties listed, or eligible for listing in the National Register of Historic Places (NRHP) are present in the area of potential effect (43 CFR Part 3160 III.E.)

Consequently, cultural resources clearance is entirely warranted to be a standard requirement for APD or NOS approval in the Abo area.

Second, if the BLM-approved cultural resources consultant's inventory of the impact areas reveals no significant resources, then the BLM cultural resources review and the clearance determination process will be completed within a relatively short time frame. In contrast, if significant resources are encountered and avoidance is not feasible, then considerably more time to mitigate adverse effects could be required before cultural resources clearance is obtained. The amount of time for completing mitigation requirements and receipt of clearance is dependent upon two interrelated variables: the amount of mitigative effort warranted and the administrative procedures required. Each of these topics is discussed below.

There are three basic mitigation action alternatives that will be required when significant cultural resources cannot be avoided within the areas of impact:

1. Testing/Evaluation Program
2. Formal Mitigation Program
3. Alternative 1 followed by Alternative 2

Administrative complexity and the amount of time required to complete mitigation specifications and to receive cultural resources clearance varies among these alternatives.

Testing/evaluation programs are the least complex of the three alternatives. The procedures entailed by such programs are designed to either (1) collect sufficient data to deplete the scientific or other values which the resource was assessed to possess, or (2) to assess whether or not potential or additional values are present within the site (e.g., the presence of intact or buried cultural deposits). Testing/evaluation programs are truly mitigative actions only when the information collected depletes the values manifested by the resource. Examples include intensive sampling and analysis of surface artifacts when subsurface testing reveals no additional cultural deposits within an entire site threatened by impact, or when similar results are obtained for a behaviorally, culturally, or analytically meaningful part of a site where only a portion of the resource is located within the zone of impact.

Testing/evaluation programs, when determined appropriate, can be performed by archaeologists at the time of survey under standard antiquities permit stipulations or when authorized by the BLM District Archeologist. Cultural resources clearance is usually obtained from BLM subsequent to the receipt and review of a short but detailed report prepared immediately after fieldwork which demonstrates that:

1. Sufficient fieldwork has been performed to extract the significant values from the site or portion(s) of the resource locus,

2. That the proposed data analyses will in fact provide valuable information concerning the history or prehistory of the region, and

3. Such information will be documented in a final report and will be submitted to BLM.

The second mitigation alternative, the formal mitigation program, generally consumes considerable amounts of time. Formal mitigation is required when the resource threatened by impact clearly exhibits both complex and a wide range of values that will require considerable effort to extract. Examples include sites that exhibit excellent preservation qualities, or are well-stratified, or are behaviorally/culturally complex. Because such resources can provide significant contributions to regional (and often national) history and prehistory, considerable professional and administrative effort is required to ensure that the program will address and extract as many of the identified values as feasible. A number of steps are therefore required to complete a formal mitigation program. First, a formal, written mitigation plan must be submitted to BLM. The plan contains the research questions and objectives, field and laboratory techniques and analytical methods to be utilized, and a full explication of other warranted techniques to be employed (e.g., chronometric, geomorphological and biotic analyses). The plan is then reviewed by the BLM, the State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation (ACHP) to assess its suitability and appropriateness vis-a-vis national as well as State Historic Preservation Plan objectives. At the discretion of BLM or the SHPO, copies of the plan may

also be submitted for peer review to other professional archaeologists or historians to ensure that the program meets professional standards. Following the review process, the mitigation plan may require revision before it is finally approved. Once approved, however, the plan can be implemented. Cultural resources clearance is obtained from BLM with the concurrence of the SHPO following the review and approval of an interim report identical in scope and content with that previously described for testing/evaluation programs.

Realistic minimum time frames for mitigation plan development and review and interim report preparation and review will probably require at least 90 - 120 days. Fieldwork time is not included in this estimate, since the amount required can vary widely.

The third alternative, testing/evaluation followed by the completion of a formal mitigation program, is the most time-consuming of the three. Such a program is warranted when it is unclear whether the full range of values contained within a threatened site has been completely identified by survey and when testing/evaluation reveals sufficient additional values that a formal mitigation program is required. An example of such circumstances applicable to the Abo area would be a site located in a dunal setting where testing and evaluation reveals that site size, complexity and integrity of cultural deposits were found to have been masked by aeolian deposits and vegetation.

The procedures for preparing and reviewing the testing/evaluation program, the formal mitigation plan and program described previously will be required. In those instances where it has been agreed that the approved formal mitigation program will immediately follow the testing/evaluation phase by the same archaeological/historical consultant organization, it is recommended in the interests of both time and cost that the detailed results of the testing/evaluation phase be incorporated into the final report documenting the outcomes of the entire mitigation program. Otherwise separate, detailed final reports for each phase will be required.

Another recommendation is proposed here that could streamline the administrative review process related to formal mitigation programs in the Abo area. Specifically it is recommended that a Programmatic Memorandum of Agreement (PMOA) developed between the BLM, the New Mexico Historic Preservation Officer and the Advisory Council on Historic Preservation regarding the preservation and treatment of cultural resources that specify the particular needs for cultural resources management in the Abo area (such as the information presented in Chapter 5). These specifications would serve as guidelines and standards that, when addressed and utilized in specific mitigation plans and programs, would greatly reduce administrative review time, and would virtually eliminate the needs for Advisory Council review.

Another essential factor which can often cause undue delays in mitigation programs is often related to the quality of the original inventory survey data. Again, it is recommended that the inventory procedures and requirements specified in section 6.1 be followed. In particular, it is extremely important that the values manifested by the resources be identified and justified in the assessment of site significance. This information, combined with the remaining site data, fulfills vital needs when determining mitigation

requirements. When the site significance assessment is missing, vague or inconsistent, then the site must be revisited, additional data collected and analyzed before the appropriate elements of a mitigation strategy can be identified.

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Appendix 1

FORMAL CHARACTERISTICS AND USE OF THE SITE LOCATION MODELS

The general form of the discriminant function equation utilized to develop the models is:

$$D_j = K + d_{j1}X_1 + d_{j2}X_2 + \ldots . d_{jn}X_n$$

Where: D_j is the score of the discriminant function j

K is a weighted constant

d is the weighting coefficient for the variables X_1, X_2, etc.

Presented below is a listing of the discriminant equation constants and weighting coefficients that were calculated for the ten models.

In order to obtain discriminant function scores (d_j values), these constants and coefficients must be multiplied by their corresponding variable (X_n) values and summed following the equation presented above. This procedure is illustrated in Table A1.2. In this table, values for the eight location variables are interacted with the weights and the constant for Model 1 (see Table A1.1). The variable-weight products and the constant are then summed, yielding the Model 1 discriminant score (10_j) for that locus.

Since there are ten models, the following information is required to determine with which model the locus is associated. First, the average (mean) and the observed minimum and maximum values for each of the eight variables within the ten data clusters are presented in Table A1.3.

Table A1.1

Discriminant Function Constants and Weighting Coefficients for the Ten Site Location Models

Equation Symbol	Variable	Model Numbers 1	2	3	4	5
K	Constant	-527.039	-613.142	-464.973	-507.931	-551.439
d_j1	Elevation Advantage	-0.210	-0.209	-0.232	-0.227	-0.201
d_j2	Local Relief	0.012	-0.001	0.040	0.055	0.022
d_j3	Distance to Water	0.079	0.052	0.037	-0.003	0.021
d_j4	Slope	0.597	0.566	0.650	0.685	0.743
d_j5	Aspect	0.031	0.030	0.030	0.029	0.027
d_j6	View Angle	0.051	0.054	0.051	0.065	0.062
d_j7	Drainage Rank	-5.893	-6.534	-6.176	-6.003	-6.160
d_j8	Elevation	0.226	0.263	0.232	0.249	0.257

		7	8	9	10	11
K	Constant	-506.439	-647.403	-444.506	-640.470	-426.921
d_j1	Elevation Advantage	-0.211	-0.158	-0.233	-0.207	-0.223
d_j2	Local Relief	0.250	-0.029	0.045	-0.028	0.042
d_j3	Distance to Water	0.057	0.088	0.019	0.114	-0.001
d_j4	Slope	0.445	0.497	0.702	0.793	0.745
d_j5	Aspect	0.034	0.027	0.031	0.031	0.032
d_j6	View Angle	0.046	0.040	0.056	0.033	0.063
d_j7	Drainage Rank	-6.023	-5.505	-6.087	-6.216	-6.050
d_j8	Elevation	0.234	0.251	0.231	0.229	0.229

Table A1.2

Example of Obtaining a Discriminant Score (D_j)

Variable Description	Variable Values	Model No. 1 Weights	Products	Discriminant Score (D_j)
Constant (K)	N/A	-527.039	-527.039	506.551
Elevation Advantage (ft)	60	-.210	-12.60	
Local Relief (ft)	120	.012	1.44	
Distance to Water (m)	2400	.079	189.6	
Slope (%)	5	.597	2.985	
Aspect (degrees)	220	.031	6.82	
View Angle (degrees)	260	.051	13.26	
Drainage Rank (rank)	3	-5.893	-17.675	
Elevation (ft)	3760	.226	849.760	

Table A1.3
Mean, Minimum and Maximum Values for the Eight Locational Variables Observed for the Ten Models

Variable		Mean	Minimum	Maximum	Mean	Minimum	Maximum
		Model #1 (Sensitivity Rank 7)			Model #2 (Sensitivity Rank 9)		
Elevation Advantage	(X_1)	37.3	0	70	46.7	20	130
Local Relief	(X_2)	71.5	30	120	72.5	30	220
Distance to Water	(X_3)	2627	2400	3200	1817	1400	2000
Slope	(X_4)	2.6	0	5	2.4	0.5	8
Aspect	(X_5)	128	0	335	116	0	345
View Angle	(X_6)	290	180	360	279	125	360
Drainage Rank	(X_7)	2.3	1	9	3.2	1	9
Elevation	(X_8)	3714	3580	3870	4317	4070	4440
		Model #3 (Sensitivity Rank 4)			Model #4 (Sensitivity Rank 2)		
Elevation Advantage	(X_1)	35	0	60	51.5	10	200
Local Relief	(X_2)	78.6	25	140	93	30	200
Distance to Water	(X_3)	1323	1100	1600	131	0	400
Slope	(X_4)	3.1	0	8	3.4	0.5	10
Aspect	(X_5)	140	0	360	124	0	350
View Angle	(X_6)	225	50	360	262	30	360
Drainage Rank	(X_7)	2.0	1	3	3.3	1	9
Elevation	(X_8)	3776	3510	4150	4078	3920	4425

Table A1.3 (continued)
Mean, Minimum and Maximum Values for the
Eight Locational Variables Observed for the Ten Models

Variable		Mean	Minimum	Maximum	Mean	Minimum	Maximum
		Model #5 (Sensitivity Rank 6)			Model #7 (Sensitivity Rank 10)		
Elevation Advantage	(X_1)	59	10	120	43	0	110
Local Relief	(X_2)	88	30	150	83	20	200
Distance to Water	(X_3)	890	500	1300	1963	1700	2300
Slope	(X_4)	3.4	1	10	2.5	1	5
Aspect	(X_5)	83	0	330	194	0	330
View Angle	(X_6)	296	110	360	215	150	360
Drainage Rank	(X_7)	3.5	1	9	2.6	1	9
Elevation	(X_8)	4226	4095	4490	3842	3625	4170
		Model #8 (Sensitivity Rank 5)					
Elevation Advantage	(X_1)	60	0	100	35	5	120
Local Relief	(X_2)	83	40	130	78	15	150
Distance to Water	(X_3)	2900	2700	3200	772	450	1000
Slope	(X_4)	2.7	1	5	3.2	1	12
Aspect	(X_5)	111	0	320	153	0	340
View Angle	(X_6)	238	100	360	228	30	360
Drainage Rank	(X_7)	5.3	2	9	2.1	1	4
Elevation	(X_8)	4219	4047	4430	3756	3530	4000

Table A1.3 (continued)
Mean, Minimum and Maximum Values for the Eight Locational Variables Observed for the Ten Models

Variable		Mean	Minimum	Maximum	Mean	Minimum	Maximum
		Model #10 (Sensitivity Rank 8)			Model #11 (Sensitivity Rank 1)		
Elevation Advantage	(X_1)	24	10	30	37	0	100
Local Relief	(X_2)	57	27	90	71	30	140
Distance to Water	(X_3)	3680	3300	4000	157	0	400
Slope	(X_4)	3.2	1.5	8	3.0	0	12
Aspect	(X_5)	148	50	290	157	0	360
View Angle	(X_6)	216	110	360	257	50	360
Drainage Rank	(X_7)	2.1	1	9	1.7	1	3
Elevation	(X_8)	3753	3600	4000	3687	3510	3900

The values in Table A1.3 were then transformed into discriminant scores (D_j) such that the mean (called a centroid) and the observed range of scores for each model were obtained. These data are presented in Table A1.4.

Table A1.4

Centroid and Range Extremity D_j Scores for the Ten Location Models

Model No.	Mean (Centroid	Observed Range Minimum	Maximum
1	519.639	466.393	572.885
2	605.875	526.357	685.399
3	460.372	388.421	564.539
4	503.667	495.178	543.254
5	544.969	511.529	592.191
7	539.567	485.163	623.524
8	644.375	599.452	702.537
9	440.128	375.279	492.060
10	633.312	557.507	694.370
11	425.208	375.209	474.329

The data presented in Table A1.4 will facilitate the process of determining which model a particular locus best "fits". This process is illustrated in Table A1.5. For this example, the variable data for the locus presented in Table A1.2 was utilized. First, the values for the eight site location variables were multiplied by the weighting coefficients and the products summed along with the constant (K) for each of the ten models (see Table A1.1). These discriminant scores (D_j) are listed in Table A1.5. Second, each D_j score was visually compared with the observed range (shown in Table A1.4) on a model-by-model basis. The outcomes of these comparisons are shown in Table A1.5. As shown in Table A1.5, the scores obtained for

Models 2, 4, 5, 8 and 9 fall beyond the ranges for these models and thus the locus cannot be associated with these. There are five instances, however, where the discriminant scores fall within the range of scores for Models 1, 3, 7, 10 and 11. In order to assess which model this locus best "fits", the score was subtracted from the group mean (i.e., centroid; see Table A1.4 for centroid values). These differences are listed in Table A1.5. As shown in this table, the smallest difference is obtained for Model 1 and thus it is most likely that this locus is more strongly associated with this model than the other four. The exact probability with which a locus "fits" a model can be more formally determined using the formula:

$$P_a = \frac{\log e\ [-0.5 \times (D_{ja} - \bar{X}_a)^2]}{\log e\ [-0.5 \times (D_{ja} - \bar{X}_a)^2 + \log e\ [-0.5 \times (D_{jb} - \bar{X}_b)^2]}$$

Where: P_a = the probability that the locus is associated with Model a when compared with Model b.

$D_{ja,b}$ = the discriminant scores for Models a, b

$\bar{X}_{a,b}$ = the centroid values for Models a, b

log e = the natural logarithm of the computed values

This formula was applied to the pairwise comparisons among Models 1, 3, 7, 10 and 11 and the results are listed in Table A1.5. The table shows that the probability of association is clearly the highest for Model 1 (82.6%), and this locus is assessed to have a sensitivity rank value of 7 (see Chapter 4 for sensitivity rank assignment).

Table A1.5

An Example of Model Association Determination

Model Number	Sensitivity Rank	D_j Score	Within D_j Range?	Centroid-D_j Score	Probability of Association
1	7	506.551	yes	13.088	82.6%
2	9	1091.146	no	N/A	0.0%
3	4	491.609	yes	31.237	0.1%
4	2	422.785	no	N/A	0.0%
5	6	463.156	no	N/A	0.0%
7	10	521.137	yes	18.430	17.1%
8	5	496.907	no	N/A	0.0%
9	3	467.703	yes	27.575	0.1%
10	8	479.107	no	N/A	0.0%
11	1	452.374	yes	27.166	0.1%

There is another highly efficient alternative method for accurately determining model membership for any given locus within the Abo area. As discussed in Chapter 4, each model corresponds to a *discrete*, geographically definable zone which is captured by the two most important variables which contribute to model membership; distance to water and elevation. Thus if the management objective is restricted to ascertaining the sensitivity ranking (or model membership) for a particular locus (rather than the exact probability with which model the locus is associated), then *only* the distance to water and the elevation variables must be monitored. If this abbreviated procedure is used, then the assessment process can be further streamlined by consulting Table A1.6.

Table A1.6

Distribution of the Models and Sensitivity Rankings

by Elevation and Distance to Water

	Distance to Water (m)								
Elevation (ft)	0 - 400	401- 1000	500- 1300	1100- 1600	1400- 2000	1700- 2300	2400- 3000	2700- 3200	3300- 4000
3510 - 3900	11 (1) *	-	-	-	-	-	-	-	-
3920 - 4425	4 (2)	-	-	-	-	-	-	-	-
3530 - 4000	-	9 (3)	-	-	-	-	-	-	-
4095 - 4490	-	-	5 (6)	-	-	-	-	-	-
3510 - 4150	-	-	-	3 (4)	-	-	-	-	-
4070 - 4440	-	-	-	-	2 (9)	-	-	-	-
3625 - 4170	-	-	-	-	-	7 (10)	-	-	-
3580 - 3780	-	-	-	-	-	-	1 (7)	-	-
4047 - 4430	-	-	-	-	-	-	-	8 (5)	-
3600 - 4000	-	-	-	-	-	-	-	-	10 (8)

* ( ) = cultural resources sensitivity rank; where
(1) = the highest and (10) = the lowest sensitivity

To illustrate the application of this abbreviated procedure, the data from the locus previously used will again be employed. As shown in Table A1.2, the distance to water value for the locus is 2400 meters and the elevation is 3760 feet. An examination of Table A1.6 shows that the combination of these two values falls within (and only within) the range for Model 1 which has an assessed sensitivity rank value of 7. Note that this procedure generates the same result obtained mathematically for this locus as shown in Table A1.5.

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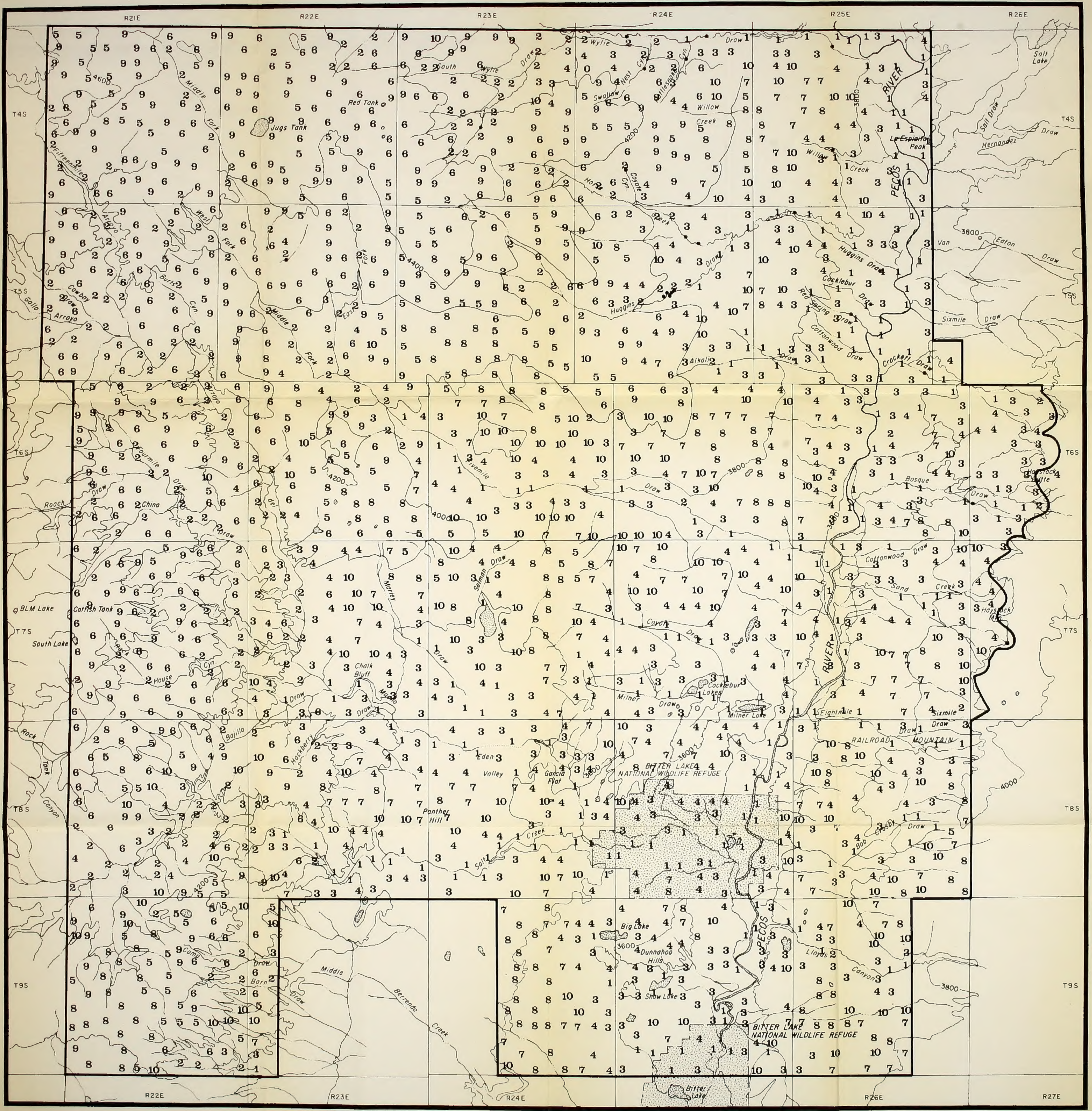
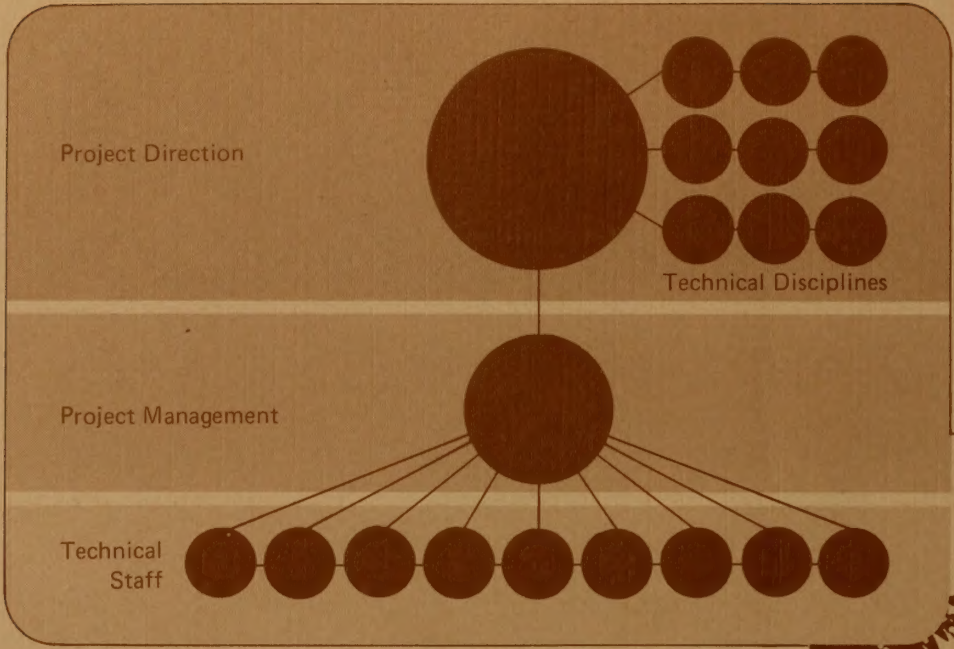


MODELED SENSITIVITY RANK VALUES FOR 2,022 OBSERVATION POINTS WITHIN THE ABO STUDY AREA

VALUES

1 = Highest site incidence 10 = Lowest site incidence

Scale 1:100,000



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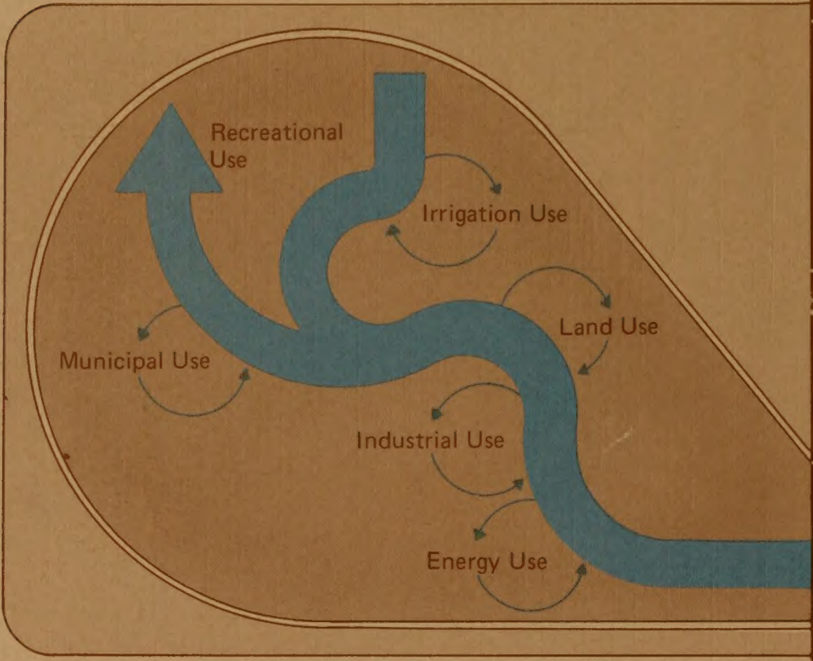

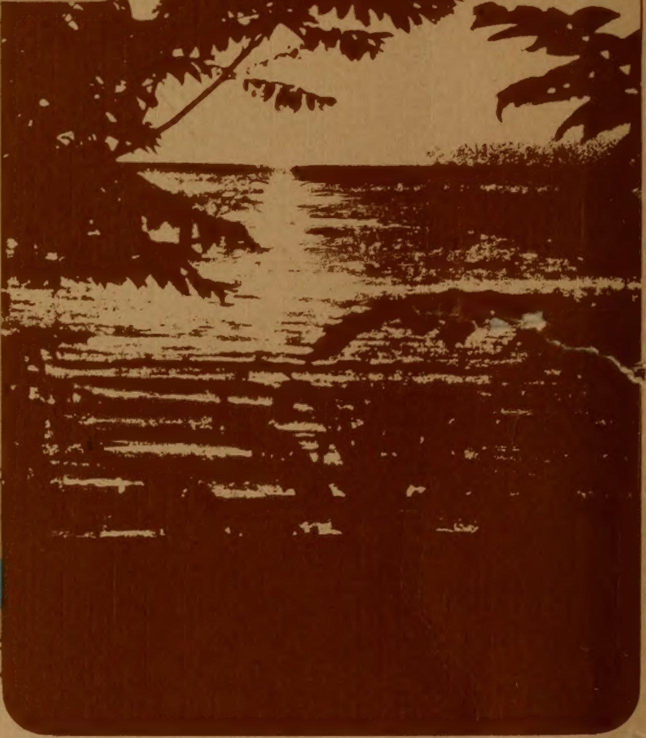

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